Coal Cost and Power Rates—Forces Exerted Between Reactors—and the Regular Departments Devoted to Operating Practice and Central Station Management.

Electrical World

New York, June 16, 1917 McGraw-Hill Publishing Co., Inc. Vol. 69, No. 24 10c a copy

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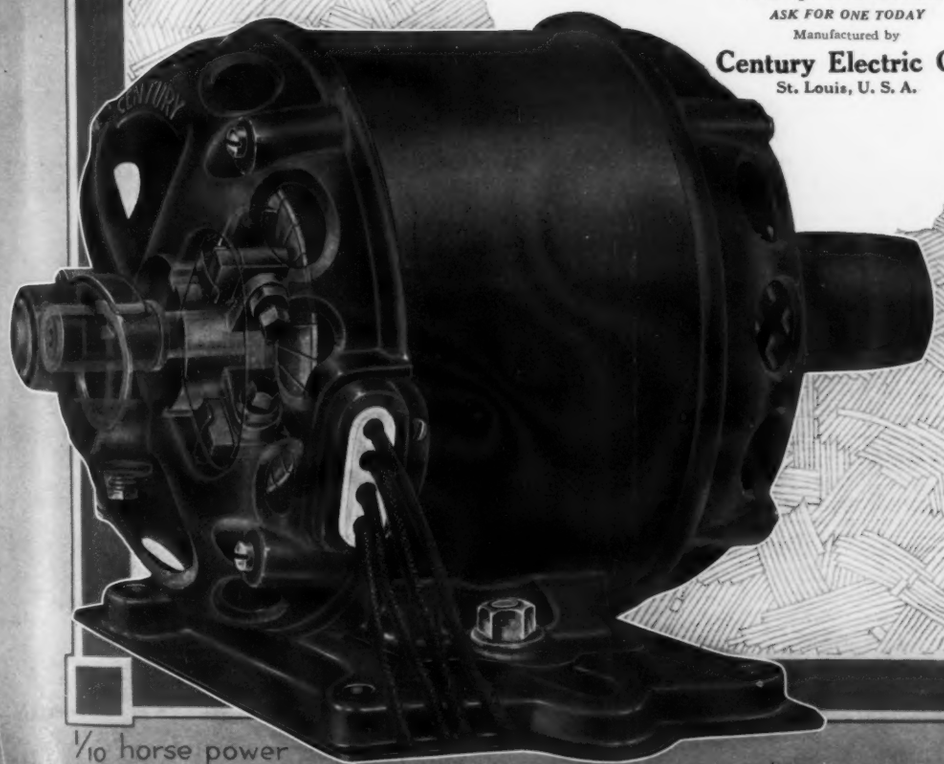

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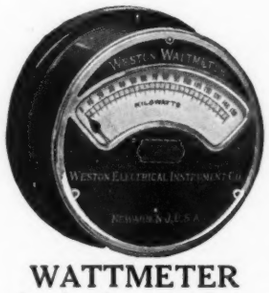

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A Lesson from Canada

WHILE central station managers in the United States have been rather restive since war was declared, wondering how they would weather the approaching storm, our Canadian friends have passed through the crisis unscathed. Bereft as some of them have been through the voluntary enlistment of fully 35 per cent of their staff, and faced also with extraordinary difficulties of financing and of securing coal, they have met the situation manfully and, instead of suffering loss, are enjoying a prosperity wholly undreamed of and never before equaled. Happily almost all of the electricity used in Canada is generated from water power so that the scarcity and high price of fuel are not felt universally in the Dominion; but the demands for energy have been so great that all steam reserve apparatus as well had to be pressed into continuous service. In the use of electricity we have much to learn from Canada. Despite the low rates prevailing there, the inhabitants have not made so generous a use of electricity in the household as one would expect, but the industries more than make up for that deficiency. With a population of about 8,000,000, scattered for the most part along the St. Lawrence River and Lake Ontario, the per capita consumption of electricity in Canada is enormous. True, the manufacture of munitions has helped to swell the figures, but the total without that is still very large. The war has caused Canadians to make a virtue out of necessity in a way very much to their credit. Had selective conscription been adopted in Canada from the start, as it has been in this country, many of the highly trained and dependable men would have been spared to the companies to help carry the burden. American managers may therefore take heart. With all their anxieties and perplexities our Canadian friends have been equal to every emergency, and, what is most encouraging, they show no sign of overwork. On the contrary, they are unusually cheerful.

The Spacing of Transformers

THE brief paper by P. O. Reyneau on this subject is well worth a second reading if one is interested in the practical economics of distribution. The general theory of the situation is that while large transformers feeding long secondaries are highly desirable on account of better efficiency and regulation, improved load factor and better diversity conditions, so far as the transformers themselves are concerned, the extension of secondaries brings with it heavy installation cost and line losses which at some point in the development of the secondary system will balance the gains to be made by the larger units. Mr. Reyneau works out from very simple theory a set of curves which furnish a most convenient graphical method for finding the approximate point at which it does not pay further to increase the transformer spacing. As in practically every case of distribution, the complete theory is hard to apply in detail, although it furnishes a convenient method of approximation. As Mr. Reyneau suggests, the curves must be used with a basis of good judgment. The irregular call for energy, the uncertain distribution of the load from week to week and the wandering of the load center of each section from hour to hour make precise application of theory an impossibility save for instantaneous values of the variables, which are not of great practical service. However, a combination of good judgment with the principles laid down by theory may generally be counted on to win. It is the data for this combination that Mr. Reyneau has given us.

Calculating Coal Cost in Power Rates

FOR the last half dozen years electric supply companies have suffered steadily from increasing prices of everything except their own product. With unrestrained speculation thrusting up the cost of living, this in turn forcing up the price for labor, and with coal simultaneously shooting skyward, the supply companies have been quite consistently reducing the price of energy. Since the war began the situation has grown worse and worse; labor is scarcer and more exacting in its demands; owners and producers, transportation men and middlemen have been greedily clutching for more profits, and with these adverse factors in operation the price of coal has surpassed all previous records.

Through this the central stations have stood pat, while all around them transportation companies were calling for help. The time has come, however, when forbearance must be laid aside and some provision made for taking care of the enormous increase in cost of production. Let it be written down to the credit of the central stations of the country that in doing this they have gone ahead logically and fairly to provide for a permanent solution of the economic problem. The method taken is shown in the case of the Rockford Electric Company discussed elsewhere in our columns. It simply amounts to placing the power schedule, in which cost of fuel is always a large item, on a sliding scale, the price to the consumer rising or falling month by month in a perfectly definite way according to the changes up or down in the price of coal. No change is made in the lighting schedule in this case nor is there

any allowance for increase of cost other than in the one vital element of fuel.

This method of dealing with the situation has very much to commend it since it virtually takes the consumer into partnership so that he can get his power cheaply when it can be produced cheaply and shares its increased cost when conditions are adverse. In every way it seems to us a more equitable and desirable way of meeting the higher cost of power due to higher coal cost than an attempt to increase power rates by a flat percentage. Any fair-minded commission should see the justice of such a proposition and authorize its adoption as a fair measure of relief to the only industry which has not taken advantage of the time of stress to try to raise its prices as much as the traffic will bear.

The Photoelectric Cell as a Photometer

THE precision of any single observation of the candlepower of a lamp in a photometer is necessarily relatively low, even with the best of observers using the best of instruments. Thus, the precision of a single measurement of the resistance of a particular sample of manganin wire may easily be one part in ten thousand, so far as concerns accidental deviations and observational errors, whereas the precision of a single photometric measurement is commonly not more than, say, one part in two hundred. In the resistance measurement a zero balance is obtained on a delicate galvanometer, and the eye has only to judge whether the scale image moves or does not move when the galvanometer is thrown into circuit. In the photometric measurement the eye itself is the detecting instrument, and the observer has to make a judgment as to the equality of two adjacent retinal images. It is practically impossible to make a discrimination beyond a certain limit of approach to equality. In order to compensate, in part, for the inherent lack of instrumental precision in the photometric observer's eye, it is customary to rely, not upon a single measurement, but upon the mean value of a fairly considerable number of photometric measurements taken by the same observer in rapid succession. Since the probable closeness to the truth of the mean of a set of measurements taken under the same contingencies increases as the square root of the number included in the set, nine measurements are collectively three times as good as one measurement in probable approximation to the unerroneous result.

It has long been recognized, however, that instead of trying to improve the approximation of the photometric measurements by accumulating the observations of one or more observers, it would be more satisfactory to substitute an artificial eye for the human eye and to develop the precision of the substituted device. This device would naturally be some form of radiant-energy detector. That this is no chimera is certified by the assertion of botanists that the "eyes," or light-responsive organs, of certain plants are much more sensitive to light than is the human eye. A certain degree of success has been obtained with photoelectric apparatus during the last few years, subject to the difficulty that the curve of sensibility with respect to wave length in the spectrum is quite different in the real and artificial eyes.

The article by James R. Randolph in our Digest this week gives some interesting quantitative comparisons between photometric tests using real and artificial eyes on one and the same electric lamp. It is to be hoped that a suitable and reliable technique can be elaborated for photometric work with an artificial eye of this kind. The real eye is, of course, the only final criterion of success in this undertaking.

Bad Illumination and Accidents

PROFESSOR CLEWELL'S discussion of the relation of industrial lighting to safety ought to be in the hands of every employer of labor. It now seems to have been well demonstrated that as illumination decreases accidents increase, regardless of whether the decrease is due to a change from natural to artificial light or to the ordinary variations of daylight resulting from the time of day or the weather. Manufacturing buildings, taking them as they run, are not well lighted either by day or by night, although some modern industrial plants are so designed as to get very satisfactory day illumination from windows. These very buildings are often poorly illuminated at night as regards either quantity or quality of light, and sometimes they suffer by reason of the ample window space through which interior light escapes as effectively as light enters.

A very large proportion of workshops do not have adequate window space as compared with the floor space, and the neighboring buildings often obstruct the entering light. In such places artificial light is practically a necessity all the time over a considerable part of the area. It is small wonder therefore that in the average factory insufficient or improper lighting soon makes itself felt through the occurrence of accidents. As Professor Clewell indicates, insufficient light, glare and shadows are the three commonest sources of trouble. The examples he gives ought to be thoroughly convincing, and almost any engineer can duplicate them from his own personal observation. At the present lamp efficiencies and low cost of energy there is absolutely no excuse for bad illumination. Glare and shadows can both be avoided by proper choice and spacing of the lighting units, of which a sufficient quantity can be easily supplied.

Just now the gas-filled lamp is productive of much bad practice in industrial illumination. It is invaluable when properly applied and intolerable otherwise. Luminous flux from this source is so cheaply obtainable that there is no possible excuse for misapplying it. In fact, bad results must be due to ignorance or parsimony —ignorance of what conditions ought to be and niggardly policy in changing to the new illuminant. Three very simple rules will avoid most of the trouble. Always keep the filament out of direct view; always screen it by some diffusing material, and keep the walls and ceiling light in color, even at some little expense of

cleaning and whitewashing. As to quantity, if the conditions just laid down are fulfilled there is no danger of overdoing illumination. On a cloudy day the maximum light furnished is likely to be considerably below daylight illumination even in a well-lighted shop. These are times when night work is of special importance, and for efficient working as well as for avoidance of accidents good illumination pays.

Looking Toward Daylight Saving

ALTHOUGH it is rather late to put through any legislation to effect daylight saving for this year, some discussion has been aroused by Senate Bill No. 1854, introduced by Senator Calder of New York. This makes the customary provisions for establishing standard legal time, duly shoved ahead one hour for daylight-saving purposes. The period of the change according to this bill would be from the last Sunday in April to the first Sunday in September, and the bill if passed will become legally effective at the beginning of the next calendar year. The more excitable advocates of daylight saving object violently to putting over a trial of the system until next season, but considering the time it has taken Congress even to struggle toward the final stages of vitally important bills like those relating to treasonable activities and food conservation, we judge that the chance of beginning daylight saving this season is very slim.

We have expressed ourselves several times on this subject, and have seen no reason to change our general opinion that the proposed plan is on the whole pleasant and harmless. It would be a boon to the enthusiastic amateur gardeners who are planting cabbageheads in hills and sowing carefully peeled potatoes. To the ordinary worker it would give a little more daylight time for recreation in the evening. But we quite fail to see where any of the enormous savings expected by the friends of the measure are going to materialize. The reputed results in England are quite impossible to verify owing to the many causes which have co-operated during the war to change the consumption of electrical energy for lighting purposes. If less coal has been burned, it may be due to any one of a number of factors, and we are very doubtful whether daylight saving had very much to do with it or would produce any large measure of economy here.

Repulsion and Inductance of Reactors

THE increasing use of reactors to limit the possible rush of current through accidental short circuits has led to improvements in the design and mounting of these devices in central stations and substations. By inadvertence, it is possible so to associate reactors in different parts of an alternating-current system that, in the event of a short circuit, the mechanical forces brought to bear upon the reactors may injure them. Moreover, if they are improperly mounted, they may mutually affect each other at all working times in such a manner as to induce mutually unbalancing emfs. The subject is dealt with effectively this week by H. B. Dwight in an article which discusses both the mechanical forces and the mutual inductances.

On first thought there does not seem to be any close connection between the mutual inductance of a set of reactors, expressed say in henrys, and the mechanical forces, or couples, which they will mutually exert on each other, expressed say in kilograms weight or in kilograms acting at a meter. Nevertheless, it is a well-known proposition that if one such reactor is, say, firmly fixed and the other is capable of making any small excursion or bodily movement, either of translation or of rotation, then the forces with which the two will pull each other magnetically in the excursion will be the product of the currents in the two reactors times the change in their mutual inductance per unit of displacement. The forces will therefore be large if the mutual inductance happens to change rapidly in the assumed displacement, while they would vanish if the mutual inductance made no change.

It is interesting to observe in the article that altering the scale of geometrical construction and arrangement, including a set of reactors, does not alter the total mechanical forces between them so long as the traversing currents remain constant. If, on the other hand, the current densities are kept constant, the forces will increase with the square of the linear dimensions.

The Coming Issues

WHILE very few lighting companies, especially east of the Rockies, face conditions in the domestic field bordering on saturation, there is a real desire to know how to increase the number of consumers per 100 population. Generally any efforts in this direction have been by forced means. In the next issue of the ELECTRICAL WORLD there will appear an article describing how through better salesmanship the number of domestic consumers is being increased in thirty-two towns in the Middle West. The national need for intensified conservation of resources is recognized universally; it can yield far-reaching economic results in the vital field of hydroelectric development. An article in the issue of June 23 will urge national encouragement to hydroelectric construction. This issue will also contain the fourth installment of C. E. Clewell's series on industrial illumination, the particular subject which will be discussed being legal requirements of factory lighting. In this article the author points out that many companies have lagged behind in bringing their lighting facilities up to requirements owing to their failure to realize the value of adequate lighting in plant production, or because they are ignorant of the advances in lighting. Attention is called to the need of expressing the legal requirements for lighting in simple terms that can be readily understood and enforced. The last issue of June, dated June 30, will be devoted principally to industrial applications.

Repulsion and Mutual Inductance of Reactors

Some Considerations That Have Been Found Necessary When Installing Coils with Parallel Axes—Curves Which May Be Used to Obviate the Use of Formulas

BY H. B. DWIGHT

OWING to the increasing use of reactors in many systems for confining disturbances to the sections in which they originate it is important to know the magnitude of their mutual inductance and the forces exerted between them. The value of the mutual inductance is useful in calculating and correcting any

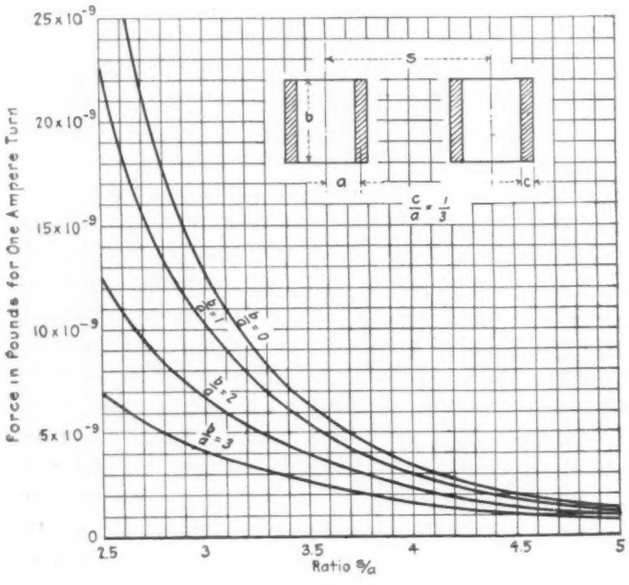


FIG. 1—MECHANICAL FORCE EXERTED BETWEEN COILS WITH PARALLEL AXES

unbalance of voltage which may be produced, while the attraction or repulsion which may exist between the coils is necessary in designing the supports and braces for the coils.

Since existing formulas which express the mutual action of cylindrical coils with air cores apply only to coils having the same axis, formulas will be derived here that will be applicable to similar coils placed side by side with their axes parallel. To obviate the necessity of using these formulas for calculations, however, curves based thereon will be presented. These curves and formulas will, it is believed, give results within a small percentage of accurate if the reactors are of the usual shape and at the usual distances apart.

Before deriving the formulas it may be pointed out that the mutual inductance of two thin solenoids A and B is the number of magnetic lines of force which interlink one coil when unit current flows in the other. This number will not be greatly changed if one of the coils be altered to have another shape of the same cross-sectional area, such as the approximately square shape shown in Fig. 5. The area of the section of the altered coil B is $m/\pi s \times 4\pi ms = 4m^2$. If this quantity is equal to the area of the round coil, πa^2, then $m = (a\sqrt{\pi}) \div 2$. Thus m is a constant which does not change when s varies.

The mutual inductance of coil A and a large concentric coil of radius $s - m$ and the same axial length b may be calculated by Searle and Airey's formula:*

$$M_1 = \frac{2\pi^2 a^2 N^2}{q}\left[1 + \left(\frac{3}{8}a^2 - \frac{1}{8}b^2\right)\frac{(s-m)^2}{q^4} + \left(\frac{15}{64}a^4 - \frac{15}{64}a^2b^2 + \frac{3}{128}b^4\right)\frac{(s-m)^4}{q^8} - \left(\frac{5}{64}a^4b^2 - \frac{5}{64}a^2b^4 + \frac{1}{128}b^6\right)\frac{(s-m)^2}{q^8} + \text{etc.}\right] \quad (1)$$

in which a is the mean radius, b the length, c the thickness of winding, s the spacing center to center, N the number of turns in each coil, $q = \sqrt{\frac{1}{4}b^2 + (s-m)^2}$ and $r = \sqrt{\frac{1}{4}b^2 + (s+m)^2}$. For the present the dimensions will be assumed to be in centimeters.

Similarly, the mutual inductance of coil A and a coil of radius $s + m$ is

$$M_2 = \frac{2\pi^2 a^2 N^2}{r}\left[1 + \left(\frac{3}{8}a^2 - \frac{1}{8}b^2\right)\frac{(s+m)^2}{r^4} + \left(\frac{15}{64}a^4 - \frac{15}{64}a^2b^2 + \frac{3}{128}b^4\right)\frac{(s+m)^4}{r^8} - \left(\frac{5}{64}a^4b^2 - \frac{5}{64}a^2b^4 + \frac{1}{128}b^6\right)\frac{(s+m)^2}{r^8} + \text{etc.}\right] \quad (2)$$

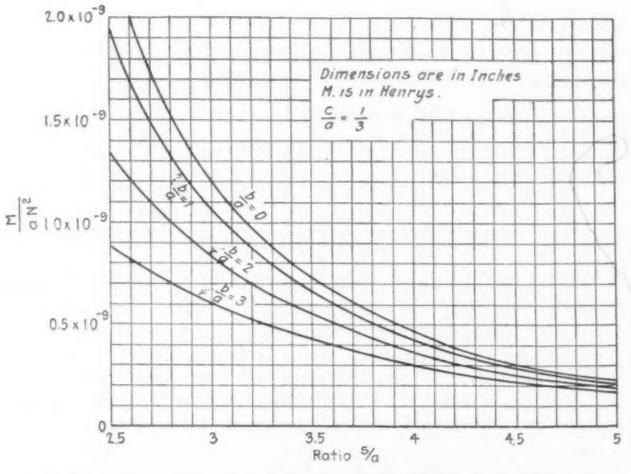


FIG. 2—MUTUAL INDUCTANCE OF COILS WITH PARALLEL AXES

The difference between M_1 and M_2 is the number of lines of force which pass through the circular belt of width $2m$ between the two large coils. Since the section of

*The *Electrician*, London, 1905, Vol. 56, page 318. *Bulletin* of the Bureau of Standards, Vol. 8, No. 1, equation 43, page 62.

the altered coil B is $m/\pi s$ times the area of this belt, the mutual inductance of coil A and the altered coil B is $m/\pi s\ (M_1 - M_2)$, in which M_1 and M_2 are given by equations (1) and (2). (3)

With coils of usual shape a small correction must be made on account of the thickness c of the winding, where the inside diameter of the coil is $2a - c$ and the outside diameter is $2a + c$. This correction may be made by means of the formula†

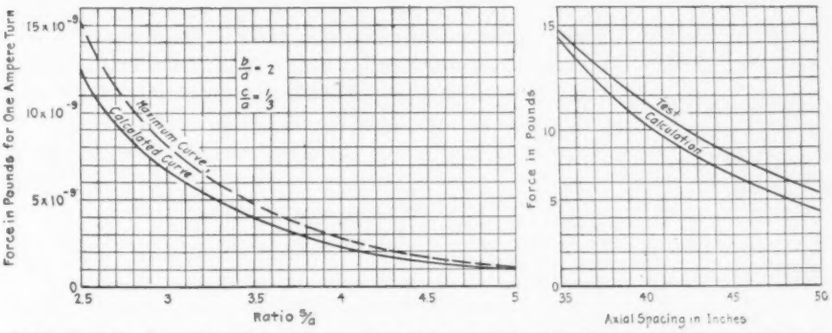
$$M = M_s + \frac{c^2}{24}\left(\frac{d^2M_s}{da^2} + \frac{d^2M_s}{ds^2}\right) \qquad (4)$$

where M is the mutual inductance of two thick coils of mean radii a and $s - m$ or $s + m$, and M_s is the mutual inductance of two thin solenoids of the above radii.

The corrected value of M_1, to a first approximation, is

$$M_1' = M_1 + \frac{\pi^2 c^2 N^2}{6q} = M_1 + \frac{2\pi^2 a^2 N^2}{q} \times \frac{c^2}{12a^2} \qquad (5)$$

Thus the first term in the series for M_1, equation (1), becomes $(1 + c^2/12a^2)$ instead of 1, and the same change is made in equation (2). It is evident that a coil with an unusually small orifice will require more correction terms in c than are given above. However, the above correction is sufficient for the usual current-limiting reactors, since the effect of the correction for thickness is only about 2 per cent in such cases.



FIGS. 3 AND 4—COMPARISONS OF FORMULA WITH MAXIMUM CURVE AND DATA OBTAINED BY TEST

When a coil is wound with large air spaces between the wires or cables, as is usual with current-limiting reactors, allowance must be made in calculating the self-inductance of the coil, but it may be neglected in approximate calculations of mutual inductance. However, in measuring the coil each dimension‡ should be taken as the number of wires or cables times the pitch, instead of the actual measured dimension over the copper, which is too small.

By including the terms in c and changing to units of inches and henrys, equation (3) becomes

$$M = \frac{2\pi a^2 N^2 m}{0.3937s \times 10^9}\left[\left(1 + \frac{c^2}{12a^2}\right)\left(\frac{1}{q} - \frac{1}{r}\right) - \left(\frac{1}{8}b^2 - \frac{3}{8}a^2\right)\left\{\frac{(s-m)^2}{q^5} - \frac{(s+m)^2}{r^5}\right\} + \text{etc.}\right] \qquad (6)$$

in which the dimensions are in inches. This equation contains enough terms for usual approximate work. If all the dimensions are in centimeters, the formula should be multiplied by 0.3937.

DERIVATION OF FORCE FORMULA

The force in dynes between two coils is exactly equal to the differential of the mutual inductance with respect to the distance between the coils when absolute units are used and when unit current is flowing. This relation may be shown by equating the mechanical and electrical work, when one coil moves a short distance ds in time dt. Thus $F\,ds/dt = -i_2 e = -i_1 i_2\,dM/dt$, since the voltage generated in the coil is equal to the rate of change of lines of force in it. Therefore, the force in dynes is $F = -i_1 i_2\,dM/ds$, where i_1 and i_2 are the currents in the two coils. Equations (1) and (2) are in forms which are readily differentiated with respect to s, giving

$$F = \frac{2\pi a^2 i_1 i_2 N^2 m}{4.45 \times 10^7}\left[\left(1 + \frac{c^2}{12a^2}\right)\left(\frac{1}{qs^2} + \frac{s-m}{q^3 s} - \frac{1}{rs^2} - \frac{s+m}{r^3 s}\right) + \left(\frac{1}{8}b^2 - \frac{3}{8}a^2\right)\left\{\frac{(s-m)(s+m)}{q^5 s^2} - \frac{5(s-m)^3}{q^7 s} - \frac{(s-m)(s+m)}{r^5 s^2} + \frac{5(s+m)^3}{r^7 s}\right\} + \text{etc.}\right] \qquad (7)$$

As in the case of straight conductors, only ratios of the various dimensions are involved in the formula for mechanical force, so the dimensions may be either in inches or in centimeters, so long as they are all in the same units. The interesting condition results, therefore, that if all the dimensions, including spacing, of a group of coils be increased by a certain ratio, the mechanical force in pounds is not changed at all.

The value of force given by formula (7) is the average force due to alternating current and is the same in value as the force due to direct current. At the peak of the alternating-current wave in a single-phase circuit the force rises to double the value given by this formula. When the momentary current becomes zero the force becomes zero.

The results of formulas (6) and (7) are only approximate for two round coils, although they may be theoretically exact for coil A and the altered coil B (Fig. 5) if enough terms of the series are calculated. Probably the closeness of this approximation can be determined best by making laboratory tests and comparing the test measurements with the calculations. However, a rough estimate can first be made by considering another alteration of coil B (Fig. 6).

This alteration of coil B is such that part of the area of section of the round coil is moved nearer to A and thus into regions of stronger magnetic flux. Therefore the mutual inductance is increased, and as the effect is accentuated at small spacings of the coils, the rate of change of the mutual inductance, and consequently the mechanical force, are also increased. Thus the mutual inductance and the repulsion of coil A and the altered coil B (Fig. 6) are considerably greater than the true values for the two round coils, as shown by the following formulas.

†See *Bulletin* of the Bureau of Standards, Vol. 8, No. 1, by Rosa and Grover, page 33. ‡See do., Vol. 8, No. 1, page 119.

The formulas giving maximum results for values of s/a less than 5 are:

$$F \text{ (in pounds)} = \frac{2\pi^2 a^2 i^2 N^2 10^{-7}}{3.26 \times 4.45(s - 0.185a)}\left[\left(1 + \frac{c^2}{12a^2}\right)\left\{\frac{1}{q(s-0.185a)} + \frac{s-a}{q^3} - \frac{1}{r(s-0.185a)} - \frac{s+0.63a}{r^3}\right\} + \left(\frac{1}{8}b^2 - \frac{3}{8}a^2\right)\left\{\frac{2(s-a)}{q^3} - \frac{(s-a)^2}{q^5(s-0.185a)} - \frac{5(s-a)^3}{q^7} - \frac{2(s+0.63a)}{r^3} + \frac{(s+0.63a)^2}{r^5(s-0.185a)} + \frac{5(s+0.63a)^3}{r^7}\right\} + \text{etc.}\right] \quad (8)$$

$$M \text{ (in henrys)} = \frac{2\pi^2 a^2 N^2 \times 10^{-9}}{0.3937 \times 3.26(s - 0.185a)}\left[\left(1 + \frac{c^2}{12a^2}\right)\left(\frac{1}{q} - \frac{1}{r}\right) - \left(\frac{1}{8}b^2 - \frac{3}{8}a^2\right)\left\{\frac{(s-a)^2}{q^5} - \frac{(s+0.63a)^2}{r^5}\right\} + \text{etc.}\right] \quad (9)$$

where the dimensions are in inches, and where

$$q = \sqrt{\frac{1}{4}b^2 + (s-a)^2}$$

and

$$r = \sqrt{\frac{1}{4}b^2 + (s+0.63a)^2}.$$

The changes in the inductance with the conditions in Fig. 6 are very much greater than with the conditions in Fig. 5, because in the latter some parts of the area are moved into regions of stronger flux and other parts into weaker, and so the changes balance each other to a large extent. By an examination of Fig. 5 it may be seen that the remainder is moved away from coil *A* into regions of weaker flux, so formulas (6) and (7) are slightly too small. Since the maximum curve of Fig. 3 is considerably too large and the curve calculated according to formula (6) is slightly too small, an inspection of Fig. 3 shows that formula (6) must be correct within a very small percentage. The values of mutual inductance given by formula (9) are larger than those of formula (7) in practically the same ratio as formula (8) is larger than formula (6). Consequently, formulas (6) and (7) have practically the same accuracy.

Formulas (6) and (7) may be useful when extended to include further terms of the convergent series of which they are a part.

Following are examples which are given to show the use of the formulas for repulsion and mutual inductance. In determining the average mechanical forces due to three-phase currents, the forces due to the products of the instantaneous values of two alternating currents which are 120 deg. out of phase are calculated in the same way as the watts due to the products of the instantaneous values of an alternating current and an alternating voltage which are out of phase.

Example I.—Find the average mechanical force acting on each of two coils carrying single-phase current, the conditions being as follows:

Mean radius of coils (in.) = a = 12.56; length of coils (in.) = b = 30.06; thickness of winding (in.) = c = 4.87; number of turns = N = 114; current (amp.) = $i_1 = i_2$ = 400, and the coils are placed side by side, with the parallel axes 45 in. apart.

From the above data, m = 11.13, $s - m$ = 33.87, $s + m$ = 56.13, q = 37.1, and r = 58.1. Therefore

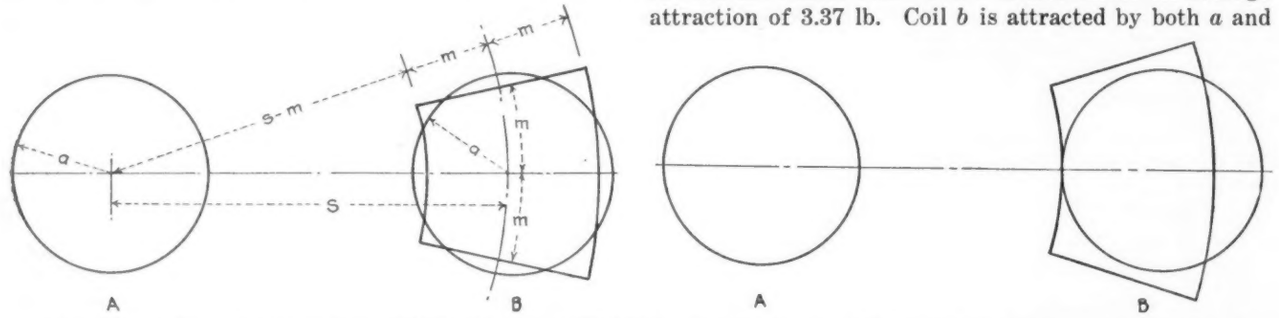
Force (lb.) = $516{,}000\,[1.0125 \times 10^{-5}(1.332 + 1.478 - 0.850 - 0.636) + 53.8 \times 10^{-8}(1.34 - 4.48 - 0.14 + 0.88)]$ = 6.25 lb. (see Fig. 4).

Using Fig. 1 for approximate work instead of formula (6), $F = 3 \times 10^{-9} \times 114^2 \times 400^2$ = 6 lb.

Example II—Find the average mechanical force on each of three coils of the same size and spacing as those in Example I, placed side by side in a row and carrying three-phase current (400 amp. per phase).

Let the three coils in a row be called a, b and c. The currents in them are 120 deg. apart in phase. The average force on a caused by I_b is 6.25 cos 120 deg. = 3.12 lb., the calculation being similar to Example I.

To find the force on a caused by I_c, formula (7) is used, the axial spacing being 90 in. The average force on a caused by I_c is 0.50 cos 120 deg. = 0.25 lb. This quantity is to be added to the force caused by I_b, making a total average force on a of 3.37 lb., tending to move it toward the center coil. Coil c is also under an average attraction of 3.37 lb. Coil b is attracted by both a and c, and although there is a momentary force, first in one direction and then in the other, the average force on b is zero. Since the above forces increase as the square of the current, they attain large values at times of short circuit.



FIGS. 5 AND 6—SECTION OF TWO SOLENOIDS AND ALTERATION OF ONE COIL TO INCREASE INDUCTANCE AND REPULSION

Example III.—Find the voltage drop due to mutual inductance in each coil of Example II, the frequency being 60 cycles.

Using formula (6), with a spacing of 45 in., $M_{ab} = 0.0081\,[1.0125(0.02698 - 0.01722) - 53.8(0.0000164 - 0.0000048)] = 7.5 \times 10^{-5}$ henrys. Also, from Fig. 2, $M_{ab} = 0.46 \times 10^{-9} \times 114^2 \times 12.56 = 7.5 \times 10^{-5}$ henrys.

Using a spacing of 90 in., $M_{ac} = 1.1 \times 10^{-5}$ henrys.

Let the currents in the three coils a, b and c be

$$I_a = 400 \text{ amp.}$$
$$I_b = -200 + j200\sqrt{3} \text{ amp.}$$
and $$I_c = -200 - j200\sqrt{3} \text{ amp.}$$

The drop in a due to mutual inductance is

$$2\pi \times 60j(I_b M_{ab} + I_c M_{ac}) = -8.4 - j6.5 \text{ volts.}$$

The drop in b due to mutual inductance is

$$2\pi \times 60j(I_a M_{ab} + I_c M_{bc}) = 9.8 + j5.7 \text{ volts.}$$

The drop in c due to mutual inductance is

$$2\pi \times 60j(I_a M_{ac} + I_b M_{bc}) = -9.8 - j4.0 \text{ volts.}$$

Power Rates Raised by Coal Cost

Alarming and Continuing Cost and Scarcity of Fuel Lead to Advances in Rates for Electrical Energy for Power—Action of the Rockford (Ill.) Electric Company Before Public Utilities Commission

AN ACUTE rate situation is raised for central stations and consumers by the alarming and continuing high cost and scarcity of fuel. Coal consumption is so great a factor in power production that the companies, large or small, cannot absorb the heavy increase in cost without either raising rates or suffering reduction in net income. On power business particularly the justice of a rate fluctuating with coal costs is receiving general recognition; the consumers affected are in business themselves; they understand readily what the companies face as a result of the abnormal coal situation. It is for this reason that so many companies are adding clauses to their power schedules as a protection against the serious conditions of last winter. In some cases this does not involve the necessity of application to the State Public Service Commission, in others the approval of that body is essential.

One of the interesting cases is that in which the Rockford Electric Company seeks the approval of a coal clause by the Illinois Public Utilities Commission. This company is controlled by the American Gas & Electric Company, of which M. F. Millikan is vice-president and general counsel.

RANGE OF COAL COST AFFECTING RATES

A supplement applicable to power rates, filed by the company with the commission, is in substance as follows:

> The rates set forth in the published schedule of the company, designated as power schedules H, I, J, K, L and M, will be the only basis of charge for power during such months as the average cost of coal f.o.b. cars on the power-plant switch track of the company in Rockford shall be not more than $2.25 per ton and not less than $1.75 per ton.
>
> For each 5 cents decrease in the average monthly cost of coal below $1.75 per ton f.o.b. cars on the power-plant switch track, there will be deducted each month from all net bills based upon power schedules to which this schedule is supplementary one-tenth of a mill per kilowatt-hour.
>
> For each 5 cents increase above $2.25 per ton there will be added one-tenth of a mill per kilowatt hour.

The total cost of coal to the company for January, February and March was:

	1916	1917	Increase	Per Cent Increase
January	$12,481	$21,822	$9,341	75
February	13,635	19,240	5,605	41
March	12,412	17,314	4,902	40
	$38,528	$58,376	$19,848	52

That increased costs are not due to increased consumption was shown by the company as follows:

	Tons Coal Burned		Average Cost per Ton		Per Cent
	1916	1917	1916	1917	Increase
January	6450	6326	$1.93	$3.45	79
February	6750	5873	2.02	3.28	62
March	5939	5550	2.09	3.12	49
	19,139	17,749			

Although uncertain how long the present situation in the coal market will last, the company says that "there seems to be no immediate prospect that the conditions will again become what has heretofore been considered normal."

Cost of coal represents practically 75 per cent of the cost of the production of electric energy, and if some provision is not made for taking care of the increase, it will mean that the company will be unable to finance the betterments, extensions and improvements which are required for the service of the public and that there can be no return to the persons who have invested in the securities of the company.

METHODS OF RECOUPING

Discussing the two methods by which increased cost might be overcome—a horizontal increase in the price of electric energy or an increase based upon increased cost coal—the company says:

"If a horizontal increase in rates be put in effect, pursuant to authority of the commission, it will be necessary in order to afford protection to the company to make the increase in rate sufficient to meet conditions of maximum cost of fuel as far as may be ascertained, based upon recent experience.

"Rates so fixed would, with reason, be maintained until basic conditions are permanently restored to a more normal condition. If so happens that there is a fluctuation from month to month the customers of the company would derive no advantage under this method.

"There is no assurance that the new schedules, however carefully established now, might not again fail to meet the situation as it may develop.

"It has seemed to the officers of the company that it would be more equitable and more satisfactory to meet the difficulty by such a supplement as has been filed rather than to ask for a straight increase in the price charged for electric energy. If a straight increase in the price charged for electric energy were asked and allowed, there is no assurance that the new schedules would not within a few months result in precisely the same situation which to-day confronts the company."

INCREASED FUEL COST ALONE COVERED

The company has submitted evidence to show that application of the proposed supplement will return only the increased fuel cost. It is not the purpose to increase net revenue in this way.

With the method proposed power customers will derive whatever advantage may accrue through favorable fuel prices during any month and will be assessed for only the additional fuel cost actually incurred to supply them with the energy they use.

The following amounts per kilowatt-hour would have been added to power bills had this supplement been in effect:

		Mills
January	$3.45 — 2.25 = 1.20 = 24 points	= 2.4
February	3.28 — 2.25 = 1.03 = 21 points	= 2.1
March	3.12 — 2.25 = .87 = 17 points	= 1.7

The revenue of the company from commercial, residential and municipal lighting, it is pointed out, is ap-

proximately one-third the total revenue, and it is proposed to absorb so long as may be possible increased operating costs on these classes of business.

The proposed increases are made applicable to power users because of the lower rates extended to them and also because of the fact that if operating individual plants (which many have done in the past) these customers would have to meet the same extraordinary increased expenses for fuel as the company; moreover, they in turn may meet a part of the increased power expense by a modification of the selling prices for their products.

Notice of the intention of the company to apply to the commission for the approval of the supplement was published for two successive weeks in newspapers of general circulation in Rockford. In addition the matter was given wide publicity among those affected by the weekly bulletin of the Merchants and Shippers' Association, practically all of whose members are power customers of the company. The secretary of that association appeared at the hearing before Commissioner Shaw and testified that not one objection had been taken to the proposed increase.

Individual Plants Similarly Affected

"Practically every power consumer of the utility," the company says, "is a potential competitor in so far as furnishing power to himself is concerned. If the power user operates his own plant, he cannot ascertain what the cost of such operation will be until long after the service has been rendered; he cannot know exactly what his fuel, labor or other elements of the cost of power will be until he has purchased the same. If his fuel contractor is unable to make deliveries, he must then have recourse to the open market and pay the prices demanded under such conditions precisely in the same manner that the utility must.

"Therefore the conditions under which he operates are essentially the same as the arrangement which we propose, although under the proposed arrangement he is still able more nearly to determine his costs because of the fact that the price of coal has been reasonably uniform for the past ten or fifteen years and up to the latter part of 1916. There has heretofore been but little or no occasion for such a supplement as is now proposed, although it has been a recognized principle in private business for a great many years that the price of the finished product should vary in accordance with the price of raw material and labor used in the manufacture of material. Industrial conditions since the outbreak of the world war have been such as to cause an enormous increase in the consumption of coal and to make it all the more difficult for public utilties to supply themselves with coal for conversion into electric energy at a price which will permit the continuance of rate schedules based upon past prevailing prices of coal.

"This company has done all that is possible to protect itself for the future. It has entered into contracts to cover its full requirements for the coming year with reputable and responsible people, but there is no assurance that these people will carry out their commitments.

"The company is increasing its storage capacity from 6000 tons to approximately 20,000 tons at a cost of about approximately $50,000 to enable it to store fuel bought under the best existing conditions to protect itself and its customers against shortage or interrupted supply. The capacity being provided will be sufficient under ordinary circumstances to supply all of the coal required by the company over a period of from two and one-half to three months.

"While it has been a fact in the past that an assurance of the stability of the cost of service has been not only desirable but necessary on the part of the utility, the existing conditions under which we now operate show the fallacy of the principle that the total resultant cost from the application of a schedule can be known in advance of the period during which service is rendered thereunder.

Application of Rate

H. C. Eddy, new-business manager American Gas & Electric Company, testified before Commissioner Shaw:

> The average cost of coal say during the month of January, 1917, was $3.45 per ton. The based price above which this schedule becomes operative is $2.25. Excess cost of coal then for January above the based price is $1.20 per ton. The kilowatt-hours generated for power supplied customers affected by this schedule during January was 1,318,093. The average efficiency of the generating plant for that month was 3.31 lb. per kilowatt-hour, which corresponds to a consumption of coal required to produce the power sold under the schedule affected by this supplement to 2181 tons; the excess cost being $1.20, it follows that the total excess cost of coal required to supply power to customers affected was $2,617.20. The additional income which the company would derive by the application of this coal clause would have been for January $2,750.80, returning thereby to the company $133.60 more than the cost of coal.
>
> The average cost of coal for February, 1917, was $3.28 per ton, representing an excess of $1.03 per ton above the based price named in the schedule. The output of kilowatt-hours required to supply customers affected by this schedule was 1,211,154. The efficiency during February was 3.51 lb. of coal per kilowatt-hour, which would correspond to a consumption of 2150 tons required to supply power customers affected; 2150 tons at $1.03 excess cost comes to $2214.50. The additional revenue returned to the company by the application of the supplementary schedule was $2211.94, leaving a deficiency of $2.56.
>
> Because of the slight variance in coal consumption per kilowatt-hour from month to month, it is out of the question from an accounting standpoint and also from a standpoint of a schedule to find a factor which shall, month in and month out, exactly return the excess cost of coal, and the figures I have submitted show that a proposed increase of one-tenth of one mill per kilowatt-hour for each 5-cent increase in the cost of coal based at $2.25 accomplishes this result with approximate accuracy.

The company mentions other similar provisions in contracts between other utilities and consumers, including that of the Commonwealth Edison Company and Chicago City Railway, the Cleveland Electric Illuminating Company and Cleveland Railway, the Atlantic City Electric Company, the New York Edison Company; the United Electric Light & Power Company, New York; the Duquesne Light Company, Pittsburgh, and the New Bedford (Mass.) Gas & Edison Light Company.

In conclusion the company urges early determination as it "is in urgent need of immediate relief from the very serious increases it has been compelled to bear in the cost of coal as well as all other materials used in the performance of its services, although it has asked no increase in its rates due to the increased cost of materials, labor and supplies other than coal."

Relation of Industrial Lighting to Safety

Varying Intensities of Illumination, Insufficient Quantities of Light, Shadows and Exposed Sources of Light Are Frequent Causes of Accidents — Examples of Accidents Caused by Improper Illumination

BY C. E. CLEWELL

Assistant Professor of Electrical Engineering, University of Pennsylvania

Adequate lighting is an important addition to the list of safety precautions for any factory, and particularly so where workmen's compensation laws are in force. The fact that the trend of casualty insurance companies is to offer reduced premium rates to well-lighted factories, or what amounts to the same thing, to penalize by higher rates the poorly lighted plant, is evidence that the well-lighted industries are beginning to be looked upon as preferred risks, other things being equal. Some typical cases where bad lighting has contributed to industrial accidents are described and illustrations are given to show wherein inadequate or poorly arranged lamps have caused such accidents. Were there no other incentive for the installation of the best available systems of illumination, the average factory could well afford to view the expenditure for lamps and wiring as a safeguard against just the class of accidents described. These features of the lighting problem, therefore, commend themselves to factory managements as of unusual and timely interest.

WIDESPREAD investigations in the past have shown that the industrial accident rate is greater where work is performed under artificial light than where it is done under natural lighting conditions. For example, Fig. 1 shows graphically the percentage of difference between accident rates under daylight and under artificial light for a given year.[1]

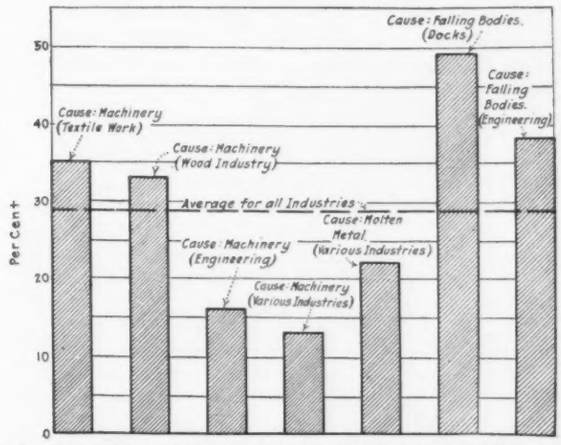


FIG. 1—PER CENT DIFFERENCE IN ACCIDENT RATES WHEN WORK IS PERFORMED UNDER DAYLIGHT AND ARTIFICIAL LIGHT

This fact in itself does not necessarily show that artificial light is the cause of the greater accident rate, but rather seems to point to poor lighting conditions as the probable cause.

The general facts indicated by Fig. 1 are further illustrated by the findings[2] of a prominent American casualty insurance company, based on a study of conditions in 1910, which show that of 91,000 accidents in and about industrial plants 23.8 per cent were due, directly or indirectly, to the lack of proper illumination. This particular company is able to give authoritative data on the subject because its specialists in accident-prevention work keep a record of every accident in and about factories and mills which carry insurance with the company. In the case of all important accidents the surrounding conditions at the time of the accident are investigated. The foregoing figures may therefore be taken as representative of the part played by poor lighting in the industrial accident rate in this country.

VARIABLE DAYLIGHT AS A FACTOR

The large differences in light intensities due to daylight within factory buildings are not always appreciated in relation to this problem. The curves[3] in Figs. 2 and 3 give some idea of the differences which may occur. Extreme variations of exterior daylight conditions like this obviously make corresponding changes in the interior illumination of industrial buildings. Factories which depend on side windows only may have spaces where the ratio of interior to exterior light is as low as 0.2 of 1 per cent. In such a case a factory space, under the conditions of exterior daylight shown by Fig. 3, will have less than one foot-candle of natural illumination in the mornings up to 10 o'clock and in the afternoons after 2 o'clock on an average December day. These figures are selected because they are typical of extreme conditions.

Many circumstances may thus combine to render light a contributory cause for an accident. The enormous intensities of exterior illumination shown by the upper line in Fig. 2 give some idea of the stimulus to the eye when the line of vision is directed through a window to outside spaces or even upon interior surfaces which receive the direct light from the sun. A sudden decrease of natural light due to heavy clouds and the transition to the very much reduced intensities common with artificial illumination may readily be a cause for inaccuracies in visual judgment.

In a similar way the transition from natural to artificial light in the afternoons of winter days, with the necessity for accommodation of the eye to the different quality and quantity of the artificial lighting, as well as variations in the directions by which the artificial light reaches the machines, must all be taken into account. It appears, therefore, that at the times when artificial and natural light are both present in the late afternoon, with a fading condition of daylight, the influence of the resultant illumination on the accident rate may also be a material factor, in distinction to conditions governed solely by artificial light, as at night.

ARTIFICIAL LIGHT AS AN INFLUENCE

The extremely serious charge against artificial light evidenced above cannot justly be based on the light, but must be attributed rather to improper artificial illumination, prominent causes of which are inadequate light,

[1] Based on a study of conditions in 1913 as given in the British factory-lighting report of 1915, page 25.

[2] Reported by R. E. Simpson, *Transactions* Illuminating Engineering Society, Vol. X, No. 9, page 868.

[3] Figs. 2 and 3 are based on the British factory lighting report previously referred to, pages 64 and 65.

glare and shadows. The provision of sufficient quantities of light and the elimination of shadows are easier to bring about than is the elimination of glare.

The blinding effect of lamps has unfortunately greatly increased with the increasing use of the vacuum tungsten lamps, and particularly with that of the nitrogen-

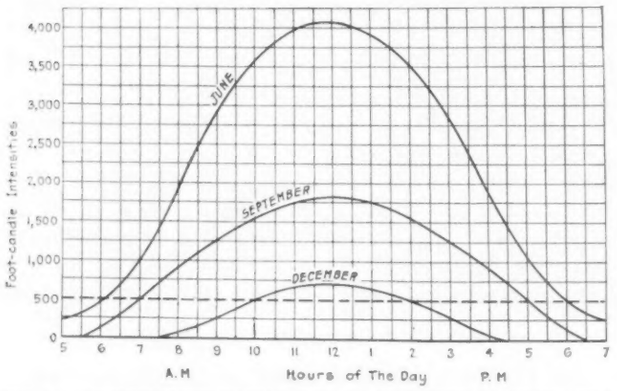


FIG. 2—APPROXIMATE VARIATIONS IN DAYLIGHT ILLUMINATION INTENSITIES UNDER OPEN SKY

filled tungsten units. In this connection, Mr. Simpson in a report (see footnote 2) goes so far as to say in effect that, while excellent results in the way of diffusion and distribution can be and have been obtained by the use of dome-type reflectors with the nitrogen-filled tungsten lamps, when viewed from the standpoint of safety, they should never be used together, unless the mounting height is sufficient to remove any possibility of the unprotected part of the lamp coming within the line of vision. Unless this policy is followed, it is inevitable that the eyesight of the workmen will be impaired, with a consequent increase in the likelihood of accidents.

While the necessity for good light in spaces used for manufacturing is great, it is very interesting to note the tendency for a large proportion of accidents to occur on stairways, in passageways and throughout infrequently used parts of factory buildings. For this reason it is perhaps advisable to emphasize the unusual importance of giving attention to the proper lighting of these spaces, which would ordinarily have a secondary place in the program of good lighting. Recent factory-lighting codes in this country emphasize this phase of the problem.

While general statements covering the relations of light to accidents are of value and interest, they have the disadvantage which is likely to follow when a problem like that of accident prevention is treated in the form of an abstract rather than a concrete discussion. For this reason several actual cases of accidents which have been due to poor light will now be introduced to illustrate some of the features mentioned above.

Actual Cases of Accidents Due to Poor Light

The first of these cases illustrates the evils of dense shadows and the need of fairly uniform illumination on the floors of passageways and aisles which are used for the transportation of materials on trucks. Fig. 4 represents a space[1] in a factory where poor lighting results from an unduly wide separation of the lamps. The lamp nearest the aisle is behind a column which casts a dense shadow on the passageway floor, thus making it practically impossible to see a flat 2-in. (5.08-cm.) iron bar which happens to be lying at an angle across the floor.

The truck which is shown was pulled along the passage by a workman who failed to see the iron bar. As a result, one of the front wheels struck the bar and thus threw the axle of the truck sharply to the right, jerking the handle out of the truckman's hand and causing it to strike the right foot of another employee who had stepped to one side to let the truck pass. This blow broke a small bone in his foot. Moreover, the sudden jar of the truck threw off one of the heavy pipes, which rolled along the truck handle and against the left leg of the same workman, breaking both bones below the knee. There is little doubt that with sufficient light at this point at least one of the two workmen would have seen the bar, and the workman normally would have removed the bar instead of trying to pull a heavily loaded truck over it.

A Crane Accident

Fig. 5 illustrates a case where incandescent lamps with steel reflectors were placed below a post crane. The post crane was struck by the load suspended from a traveling overhead crane, and the shock knocked a steel beam from the grab hooks of the post crane and caused injuries to employees who happened to be beneath. The overhead-crane operator asserted that he could not tell that the load was being carried near enough to the floor to strike the post crane.

From the illumination standpoint, two features are to be noted in this accident—first, the difficulty experienced in seeing the work on the shop floor because of the inadequacy of the general lighting system, and, second, the disadvantage in the use of lamps near the

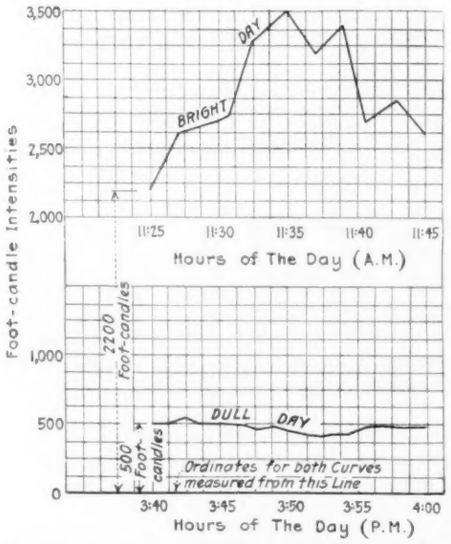


FIG. 3—VARIATIONS IN MEASURED ILLUMINATION INTENSITIES UNDER OPEN SKY IN MARCH

floor and under projections such as this post crane, because of the fact that the post-crane projection was by their use cut off from all upward light and was rendered invisible from overhead when viewed at sharp angles by the crane man in approaching this part of the shop from a distance.

As pointed out previously, one of the worst features

[1] The description of each of these cases, together with the arrangements for the sketches, is due to R. E. Simpson, engineer with the Travelers Insurance Company, Hartford, Conn. See also "Illumination and One Year's Accidents," *Transactions* I. E. S., Vol. X, No. 9, page 868.

Fig. 4—Jar caused by truck striking bar concealed by shadow on floor knocked truck handle from workman's hand and dislodged pipe, thereby breaking other workman's leg.

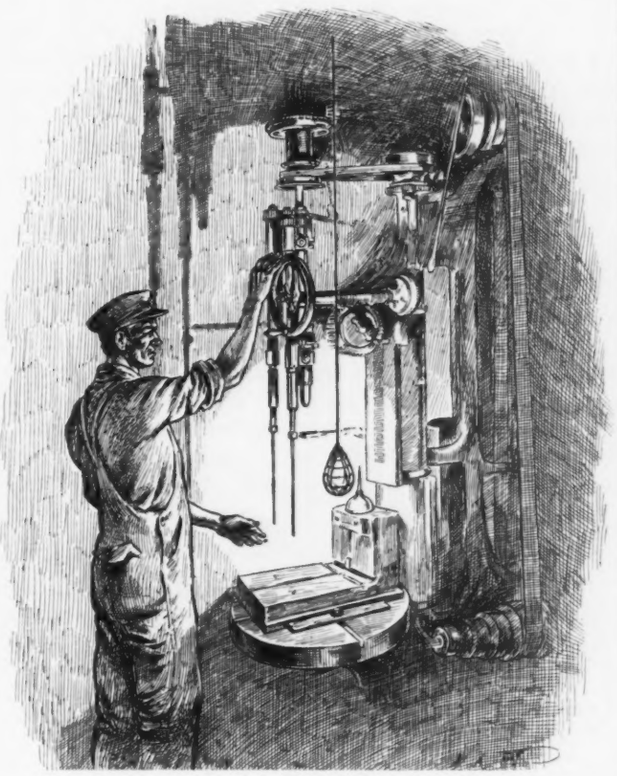


Fig. 6—Blinded by the glare of the bare lamp over the drill-press table, the operator stuck his fingers between gears while reaching for the drill-press feed control.

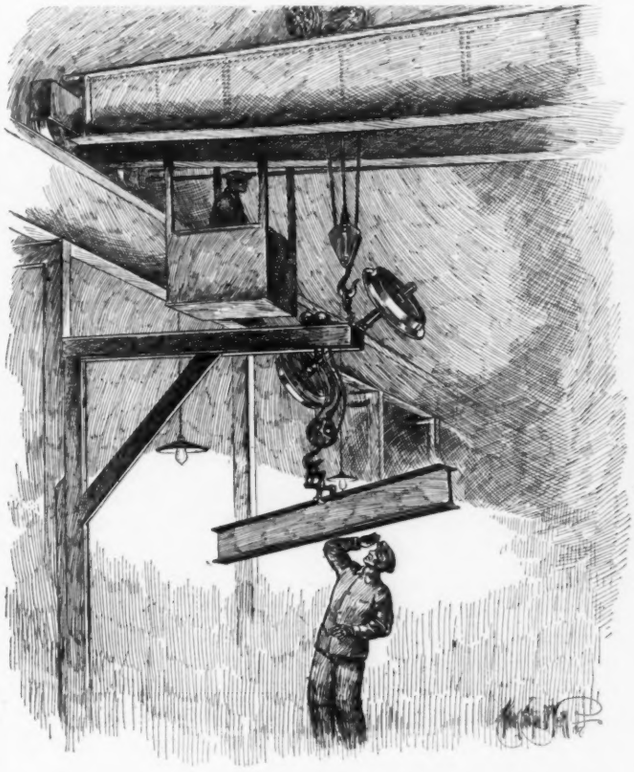


Fig. 5—Beam knocked from grip of post crane because poor lighting failed to disclose its presence to the operator of the overhead traveling crane carrying car wheels.

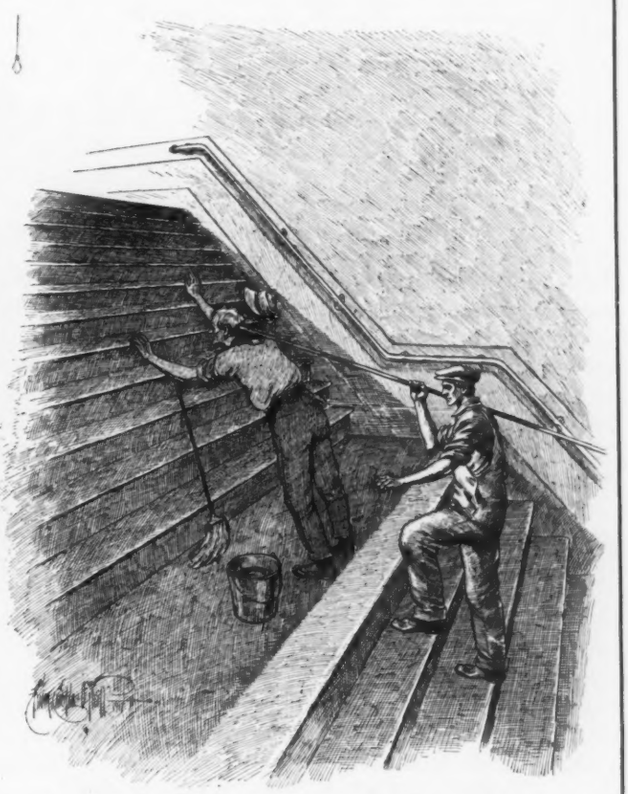


Fig. 7—Owing to inadequate lighting the man cleaning the stairs was struck in the back of the head by an iron bar carried by the man ascending the stairs behind him.

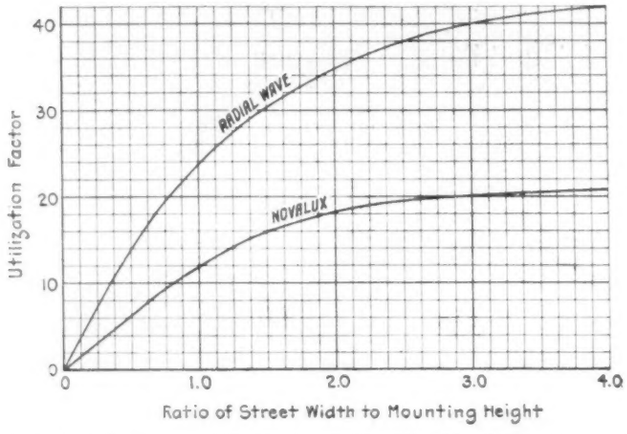
EXAMPLES OF HOW INADEQUATE LIGHTING CAUSES ACCIDENTS

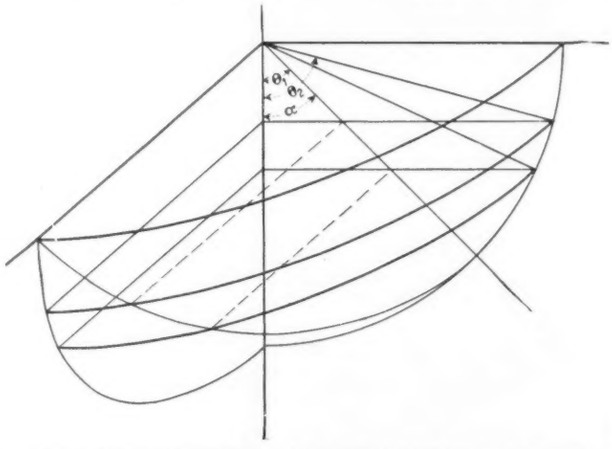
of modern lamps when unshaded is the blinding or glare effect produced when a workman changes his line of vision from directly toward such a bright lamp to another space with less light. At the instant of making such a change in his line of vision he is temporarily blinded and is thus unable to see the less brightly lighted objects. In Fig. 6 the conditions surrounding an accident from such a cause are shown.

The workman had been operating a drilling machine, which was lighted by an unshaded lamp close to the work. In the normal operation of this drill he was forced to view the work with the bright lamp in front of his eyes. In attempting to adjust the drill by means of a wheel above his head he placed his hand in the gears, and thus received severe lacerations and bruises, because of the temporary blindness produced by the filament of the bright lamp. It is almost needless to remark here that the proper shading of such a lamp should be considered as of equal importance with the mechanical protection of the gears, if accidents of this kind are to be avoided.

A Case of Totally Inadequate Light

The three cases just described and illustrated refer, in general, to defects in poorly arranged lighting in the form of shadows, improperly arranged lamps and glare.





FIGS. 1 AND 2—UTILIZATION FACTORS FOR TWO TYPES OF LIGHTING UNITS; ZONES CONSIDERED IN DERIVING FORMULA AND CURVES

The case illustrated by Fig. 7 is one of totally inadequate light on a neglected stairway. A janitor was attempting to sweep the steps in virtual darkness. A second workman approached the stairway carrying a bar of iron on his shoulder and because of the darkness did not see the janitor in his pathway. As a result the iron bar struck the janitor on the back of the head, causing a severe scalp wound.

Cases of this kind may seem out of place for illustrating various phases of the accident problem, and yet they are typical of the kind of accidents which go to make up the enormous list that occurs year after year in this country. It is a striking fact that the inspectors of casualty companies, because of their distinct interest in accident prevention and their duty to recommend changes in conditions which appear to increase accident hazard, have many opportunities to suggest remedies in poorly lighted factory spaces.

Auxiliary Lighting for Safety

The failure of the regular lighting system when a large night force is at work can readily contribute to panic, with the attending dangers. The recently enacted Pennsylvania and New Jersey lighting codes, therefore, require that all factories shall be provided with an auxiliary system of lamps in some form which shall be thoroughly dependable at all times. In neither of these codes is there any specific outline as to just what shall constitute such an auxiliary system, and this, in fact, has been one of the points raised for settlement since the codes became effective in 1916. Up to this time there does not seem to have been any definite ruling on this question by any of the state departments.

UTILIZATION FACTORS FOR STREET-LIGHTING UNITS

Method of Calculating Flux Incident Upon Street Surfaces from the Zonal Candlepowers of the Lighting Units

BY EUGENE PETERSON

All methods in practical use to-day for determining the mean horizontal intensity of illumination along a street seem to be based upon the determination of the illumination at a number of points more or less representative of the street as a whole. Disadvantages in this method of procedure, at once apparent, make it advisable to seek other means for its solution, the most feasible of which is perhaps that involving the computation of the average intensity as the quotient of the incident flux divided by the surface area.

In a paper presented before the Illuminating Engineering Society in 1910 Preston S. Millar developed curves for what were then some of the most generally used illuminants, illustrating the variation of the percentage light flux effective upon the street as affected by varying the street dimensions. Unfortunately, the graphical method used in the construction of these curves does not lend itself very readily to specific application, so that the solution given below has been developed from the writer's work at the Electrical Testing Laboratories to meet that requirement.

First, it is considered that a light source is mounted at a height h directly over one side of a street of width w, as shown here. Under these conditions it may be seen that the flux directed toward the street is included within two planes passing through the two sides of the street and intersecting at the luminous center of the source. Consideration of the light in this manner involves two assumptions, (1) that there are no reflecting

surfaces to redirect flux toward the street, and (2) that the street is straight and infinitely long.

The first and obvious method of attack would be to integrate the flux over the area of the distribution surface of the unit cut off by the two intersecting planes, but the actual solution is not so simple. Perhaps it might be advisable to show just why distribution curves are not in general susceptible of direct mathematical treatment. In the great majority of cases the distribution (curve) is symmetrical about its vertical axis,

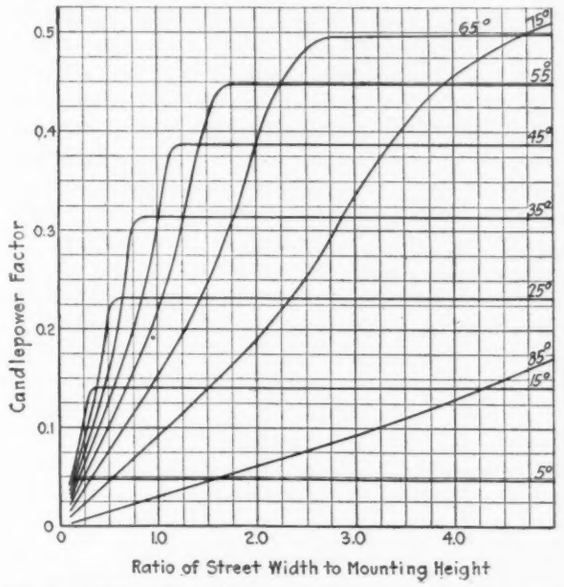


FIG. 3—EFFECT OF RATIO OF STREET WIDTH TO MOUNTING HEIGHT ON PER CENT ZONAL FLUX REACHING STREET

hence the distribution surface is a surface of revolution, formed by rotating the curve about this axis of symmetry. Because of the irregularity of such curves, probably no one equation could be made to fit an entire curve; therefore it is necessary to piece it out by equations for small components. Not only this operation but the integration for the surface, however simple the curve might be, leads to extremely complicated expressions. Therefore, since the above process would have to be carried through for every distribution curve and for every ratio of street width to mounting height, it is evident that the direct method is unsuitable.

It is almost unnecessary to state that with a source having a uniform distribution of 1 cp. (the total flux due to which is consequently 4π lumens) the flux issuing from any particular portion is equal numerically to the area of that particular portion, and if the candlepower is other than unity the flux is computed as the product of the candle-power and the area of that portion. This forms the basis for a solution which considers the effective flux from each zone; the total effective flux is then the summation of the effective zonal fluxes.

Since distribution curves are usually determined with sufficient accuracy by specifying the candle-power at 10 deg. intervals, the lower hemisphere can be divided similarly. For zones making small angles with the nadir, probably all the zonal flux falls upon the street, but as the angle increases the proportion of effective to total zonal flux becomes smaller and smaller until at 90 deg. and greater angles from the nadir none is effective. Thus it follows that the effective zonal flux is found from the zonal area included between the intersecting planes and the representative candle-power obtained from the distribution curve. It now remains to derive a general expression for the area of a zone with bounding angles θ_1 and θ_2 cut off by a plane making an angle $\alpha = \tan^{-1} w/h$ with the reference plane (see Fig. 2). This may be effected by ordinary calculus* as follows:

$$\frac{A}{2} = \int_{\cos\theta_1}^{\cos\theta_2}\int_{0}^{y\tan\alpha} \sec\alpha\, y\,dy\,dx = \int_{\cos\theta_1}^{\cos\theta_2}\int_{0}^{y\tan\alpha} \frac{dx\,dy}{\sqrt{1-x^2-y^2}}$$

$$= \int_{\cos\theta_1}^{\cos\theta_2} \sin^{-1}\frac{y\tan\alpha}{\sqrt{1-y^2}}\,dy$$

By parts:

$$= \left[y\sin^{-1}\frac{y\tan\alpha}{\sqrt{1-y^2}}\right]_{\cos\theta_1}^{\cos\theta_2} + \int_{\cos\theta_1}^{\cos\theta_2} \frac{y\tan\alpha\,dy}{(1-y^2)\sqrt{1-y^2\sec^2\alpha}}$$

According to Peirce's integral table No. 230:

$$\left[\tan^{-1}\frac{11}{\sqrt{\frac{1-y^2\sec^2\alpha}{\tan^2\alpha}}}\right]_{\cos\theta_1}^{\cos\theta_2}$$

Therefore

$$A = 2[\cos\theta_2\sin^{-1}(\cot\theta_2\tan\alpha) - \cos\theta_1\sin^{-1}(\cot\theta_1\tan\alpha)$$
$$+ \tan^{-1}\sqrt{\frac{1-\cos^2\theta_2\sec^2\alpha}{\tan^2\alpha}} - \tan^{-1}\sqrt{\frac{1-\cos^2\theta_1\sec^2\alpha}{\tan^2\alpha}}]$$

For any given zone, then, the effective flux varies with the ratio w/h. In the accompanying curves it has been plotted for 10 deg. zones from zero degrees to 90 deg. with the zone factors as ordinates and the ratios of w/h as abscissae. The zone factor A in the formula is that quantity by which the zonal candle-power is multiplied to give the effective flux. It is obtained from the derived equation.

To take a concrete example, suppose a radial wave unit is mounted 20 ft. over the center of a street measuring 80 ft. between building lines. Dividing the street surface by the reference plane which passes through the center of the unit and the center line of street, two surfaces equal in area and similarly placed are obtained. Hence the total incident flux is twice that on either surface.

Since the total flux is 843 lumens and the effective flux, 586.4, $= 293.2 \times 2$, then the ratio of the effective to the total flux—what might be called the *utilization factor*—is $586 \div 843$, or 69 per cent. The variation of the utilization factor with changes in the ratio w/h is shown in accompanying curves for two units of widely different distribution characteristics—one utilitarian, the other esthetic. The utilization factor depends not only upon the distribution characteristics of the unit, but also upon the street width and mounting height. If two units with different distribution characteristics are to be compared with respect to the amount of light they direct toward the street, the comparison should be made with the same value of w/h for both.

It should be emphasized that the calculations previously made refer only to the directly incident flux. Where buildings are present a considerable increase in illumination may be obtained by reflected light, for which no means of calculation has been made available. A fair approximation may be made, however, by applying to the flux incident upon the building fronts (as computed by the preceding method) coefficients deduced from experimental data.

*Byerly, W. E., "Integral Calculus," page 164.

Economical Spacing of Transformers

Relation Between Transformer Size and Spacing and Wire Size—How Allowances Must Be Made for Departure from Ideal Conditions—Allowing for Growth of Load

BY P. O. REYNEAU*

Distribution Engineer the Detroit Edison Company

ECONOMICAL arrangements of distribution transformers can be determined only by comparing the cost of secondary wire, cost of transformers, cost of installation, core and copper loss charges, inspection charges, etc. However, if two or more of these variables are fixed either by the conditions of load to be expected, where a new system is being laid out, or by the actual equipment installed, where improvements are being made on an existing system, very satisfactory analysis can be made with the help of the accompanying curves. For instance, with the size of wire and transformers fixed the curves show the spacing of transformers which will keep the voltage drop on continuous secondary mains within allowable limits and will not overload the transformers.

Three curves are shown for the three sizes of secondary wire commonly used. Each curve is plotted to show the load in kilowatts that can be transmitted for different distances on a three-wire secondary with a 3 per cent voltage drop at 224 delivered volts with the load uniformly distributed and the transformer at the center of the main. This is the same condition which obtains with continuous secondary mains and equal spacing of transformers.

Basis for Curves

The curves embody a combination of two formulas†: $A = (D \times W \times C) \div PE^2$ and $V = PB$, in which A = area of conductor in circular mils; D = distance one way from source to receiver in feet; W = load in watts; C = a constant depending on the power factor and the resistivity of the conductor = $(2\rho \times 100) \div \cos^2\theta = 2400$ for 95 per cent power factor and $\rho = 10.82$ ohms per mil foot, for stranded wire; P = per cent power loss of delivered power; V = per cent volts loss of delivered volts; E = receiver voltage, and B = a constant for any given size of wire, spacing, frequency and power factor which may be quite accurately determined for any assumed limits of current and length of line.

If $P = V \div B$ is substituted in the first formula it becomes $A = (D \times W \times C \times B) \div (V \times E^2)$, or $W = (A \times V \times E^2) \div (D \times C \times B)$.

If V, the per cent volts loss, is assumed, say at 3 per cent, and the receiver voltage is assumed to be held constant, say at 224 volts, for any given size of wire, A and B are fixed and the formula becomes W = a constant $\div D$.

This constant was determined for the various sizes of wire and the resulting formulas were plotted as shown. D in the above formula is the distance one way from the source with concentrated load. In this special case, where the distance between banked transformers is used, with uniformly distributed load, it may be considered the same as the case of a length of line with the transformer in the center and load uniformly distributed. Thus the total load on the transformer is divided by two, half each side, and the distance each way with uniformly distributed load may be considered the same as one-half that distance with concentrated load. Hence D = distance between transformers $\div$ 8. The curves give the relation between the total load on a transformer and the spacing of transformers for 3 per cent voltage drop.

For general conditions it can be assumed that the load on the secondary mains is uniformly distributed. This is especially true of residence districts where the houses are all of about the same class, and is also more or less true of business districts. Where the two classes of load are in the same secondary bank each must be considered separately. At certain points in a secondary bank there may be large loads caused by a theater, apartment house, large store or something of that nature. These can be taken care of usually by figuring proper size and spacing of transformers for the bank exclusive of these large loads and then placing transformers near enough to the service taps of these large loads to prevent excessive drop in the secondaries and making the transformer large enough to handle the extra load. In some cases it may even be preferable to handle these large loads on separate transformers.

In caring for loads which are more or less uniformly distributed along the secondary mains it becomes convenient to determine the "density of load" in kilowatts per 1000 ft. (304.8 m.) of three-wire secondary. This is done by dividing the load on any secondary main (obtained by test or other means of estimating) by the length of the main in thousands of feet. Since the accompanying curves are plotted for distance between transformers against kilowatts transmitted by each transformer, radial lines from the origin will be lines of constant load density. By the use of these lines in connection with the curves the best conditions of installation for each density of load may be readily determined. It is also convenient in the use of these curves to ink in the vertical lines representing the load capacity of the standard sizes of transformers used, as the spacing of transformers is limited by the load capacity of the transformers used as well as the voltage drop, and it is also important that the transformers should be working fairly well up to capacity.

How the Curves Are Used

Probably the best method of showing the use of the curves is by a practical example: For instance, in a given district having banked secondaries of No. 4 wire suppose the load tests on present transformers show an average load density of 5 kw. per 1000 ft. (304.8 m.). Finding the point where the line of 5-kw. density intersects the curve for No. 4 wire, it can be seen that this

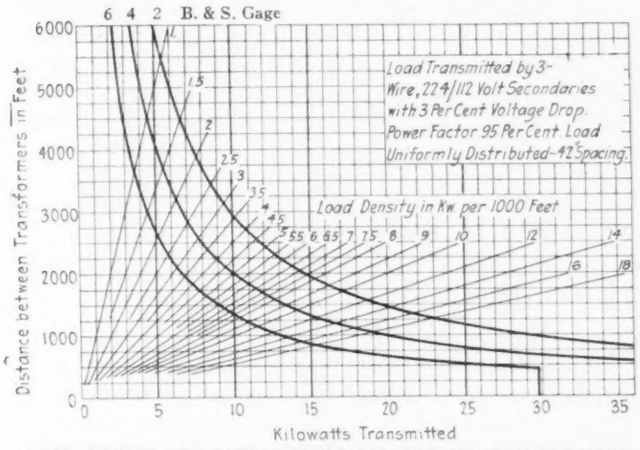
*The author wishes to express his indebtedness to Harold Cole for his valuable assistance in preparing the article.

†The use of these equations was suggested by an article by Harold Goodwin, Jr., published in the *General Electric Review*, December, 1914. The values of B in the second equation used here are not those found in the above article, but have been determined to suit the conditions of the system to which they were applied.

load could be carried by transformers spaced 2000 ft. (609.6 m.) apart with a 3 per cent voltage drop under the ideal conditions assumed. The load on each transformer would be 10 kw., therefore 10-kw. transformers would be necessary.

However, it would hardly be advisable to space transformers up to the limit permitted by the drop in this manner. Several conditions would interfere. In the first place, the load would not be exactly uniformly distributed and the drop would be greater than 3 per cent in some places. In the second place, the load tests would never represent the peak load throughout the season and there would be a greater voltage drop under peak-load conditions. In the third place, this method does not make any allowance for growth.

A safe method of taking care of such unknown conditions obviously would be to allow for a greater density of load than that shown by tests. The amount of this


6 4 2 B. & S. Gage
Distance between Transformers in Feet
Kilowatts Transmitted
Load Transmitted by 3-Wire, 224/112 Volt Secondaries with 3 Per Cent Voltage Drop. Power Factor 95 Per Cent Load Uniformly Distributed-42' Spacing.
Load Density in Kw per 1000 Feet

LOAD CURVES FOR DETERMINING SPACING OF TRANSFORMERS

allowance would naturally depend upon the character of the district served. In a district which is entirely built up the increase in load from year to year will not be so great as in districts which contain a large number of vacant lots and are building up rapidly. Where the increase is expected to be fairly rapid it will usually be best to make the transformer spacing suitable for the higher densities and large transformers and then use smaller-size transformers until they become overloaded, at which time they can be replaced by the large size. In this way considerable saving is effected owing to the fact that the transformers are replaced in the same location and the expense of framing transformer poles is eliminated.

ALLOWING FOR GROWTH OF LOAD

Assuming therefore in the present case a density twice as great as found from tests, say 10 kw. per 1000 ft. (304.8 m.), it will be found from the curves that with No. 4 wire transformers could be spaced 1400 ft. (426.5 m.) apart for a 3 per cent drop. The load on each transformer with this condition would be 14 kw., and it would be necessary to use a 15-kw. transformer when the load density came up to the assumed value. The transformer, however, could never be loaded up to capacity with this spacing without giving a greater voltage drop than that allowable. It would therefore be best to space the transformers so as to allow for full load on a 15-kw. transformer before the drop becomes excessive. This would mean a spacing of 1300 ft. (396.2 m.) or less.

With a spacing of 1300 ft. (396.2 m.), however, 10-kw. transformers could be used to carry a load density of 7.5 kw. per 1000 ft. (304.8 m.), which would in the case assumed probably be satisfactory for a year or two. Then as the transformers became overloaded they could be replaced by 15-kw. transformers, which would add sufficient capacity to last several years.

It may be of assistance in becoming familiar with the curves to note the significance of the location of any point with respect to the curves. In general, all points below the curve for any wire size indicate that the voltage drop will be less than 3 per cent; all points on the curve indicate that the drop will be 3 per cent, whereas all points above the curve indicate that the drop will be more than 3 per cent for that particular condition.

To take a simple example first, suppose a 10-kw. transformer has a load of 8 kw. on a secondary main of No. 6 wire, 2000 ft. (609.6 m.) long, with the transformer located at the center of the main. The intersection of the 8-kw. line with the 2000-ft. distance line is a point above the curve of No. 6 wire and shows that the drop at the end of the secondary main is very likely more than 3 per cent. The point of intersection, incidentally, is also on the line of 4-kw. density, which, however, might have been determined beforehand by dividing the load (8 kw.) by the length of the secondary main, 2000 ft. (609.6 m.).

An example of the more general application of the curves would be as follows: With No. 6 wire and 10-kw. transformers, for any load density up to 7.5 kw. per 1000 ft. (304.8 m.) the proper spacing of transformers is determined by the size of the wire and the transformer cannot be fully loaded without having more than 3 per cent drop. This can be seen by referring to the curve. With a load density of 4 kw. per 1000 ft. (304.8 m.) 10-kw. transformers would have to be put 2500 ft. (762 m.) apart to be fully loaded, as shown by the intersection of the 4-kw. density line and the 10-kw. transformer line. This point of intersection, however, is far above the curve for No. 6 wire and the drop would be much more than 3 per cent. It would be necessary to use No. 2 wire to keep the drop below 3 per cent, as the point falls below the curve for No. 2 wire.

On the other hand, with No. 6 wire and 10-kw. transformers, for any load density above 7.5 kw. per 1000 ft. (304.8 m.) the proper spacing of transformers is determined by the transformer capacity. For with a load density of 10 kw. per 1000 ft. the transformers would be fully loaded with a spacing of 1000 ft. (304.8 m.). The intersection of the 10-kw. density line and 10-kw. transformer line in this case falls below the curve for No. 6 wire and the voltage drop is therefore less than 3 per cent. The 7.5-kw. density line, the 10-kw. transformer line and the No. 6 wire curve all intersect at a point showing that 1250 ft. (381 m.) is the ideal spacing for 10-kw. transformers and No. 6 wire.

It should be evident from the foregoing discussion that these curves do not determine exactly the conditions which would obtain in any specific case, but that they must be used more as a basis for good judgment. Practical differences between the ideal conditions assumed and the actual conditions encountered must be handled by making suitable allowances in spacing of transformers, by judicious location of transformers near the heavier loads, and by proper allowance for growth and inaccuracy in testing or estimating loads.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

IMPROVING COAL ECONOMY

Mixture of Screenings and Bituminous Coal Found Economical by Massachusetts Company

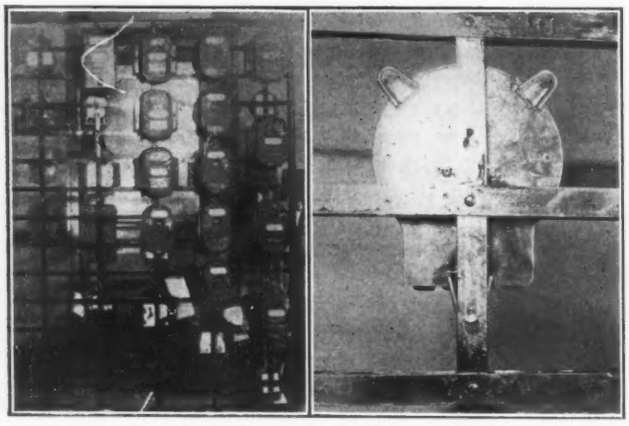
Tests have been conducted with Pennsylvania coal and New River coal by the Concord (Mass.), Maynard & Hudson Street Railway, and although the former costs less per ton, it has been found that a lower cost per kilowatt-hour is obtained with the New River because the amount of ash produced is less than with the Pennsylvania coal. The latter is difficult to use under the conditions obtaining in the railway company's plant as it clogs the grates, necessitating the employment of more men in the boiler room than with New River coal.

By mixing bird's-eye hard-coal screenings with bituminous coal of the "carbon four" grade, in the proportion of one to one, the Concord (Mass.) electric plant finds it can produce energy at lower cost than with Pennsylvania coal alone. Without a test it is difficult to tell whether the cost of production can be lowered by using New River coal, but the mixture of screenings and Pennsylvania coal gives entirely satisfactory results, according to A. W. Lee, manager of the plant.

ADJUSTABLE METER RACK

Made of Simple Materials and Designed to Support Meters of Any Size in Convenient Positions

The meter rack shown in the accompanying illustrations is made of 1.5-in. by 0.25-in. (3.8-cm. by 6.4-mm.) strap, channel and T-iron. All uprights except the end pieces are made of two pieces of channel iron



FIGS. 1 AND 2—RACK SUPPORTING DIFFERENT TYPES OF METERS AND DETAIL OF RACK

riveted with the open sides of the channel face to face. The end uprights are T-iron. In the vertical channel-iron members between the intersections with the horizontal pieces of strap iron are punched slots resembling keyholes. Special plugs are made to fit these holes. One of the plugs may be seen on the strap iron in Fig. 2.

The use of the two channel irons makes it possible to hang meters on both sides of the rack. The plugs or pegs, being easily removable, can be taken out when they are not supporting meters and hence are not likely to catch the clothes of workmen or otherwise to act as obstacles. Edgar A. Felsenkeller of Milwaukee, who designed this rack, stated that in building another he would use similar pegs instead of rivets to make the joints between the channel iron and the horizontal strap-iron pieces. This change would permit the horizontal pieces to be moved to closer or wider spacings at will for the most convenient hanging of meters of different sizes.

HINTS ABOUT TESTING OIL

Importance of Determining Minimum Breakdown Voltage and Other Considerations

BY ALBERT MARTINEAU

Three breakdown tests will usually give a typical indication of the dielectric strength. However, it is well to remember that it is the minimum not the maximum voltage that is the criterion as to insulating properties. One extremely low-puncture voltage with two high ones indicates the presence of foreign particles between electrodes, and a fourth test should be made. Three low values usually indicate truthfully the presence of moisture. If the breakdown voltages become lower and lower as successive tests are made, it is probable that carbonized particles of oil are floating within the electrostatic field.

When using so small a quantity of oil as 1 pint (0.47 l.), it is important for accurate results to agitate the oil violently after each puncture, aiming to wash out from between the electrodes burnt oil and other foreign particles the presence of which lowers the puncture voltage. Not only is it advisable to swish the oil around to wash out horizontally between electrodes, but the movement of the top electrode up and down vertically assists the removal of air bubbles upon the top electrode.

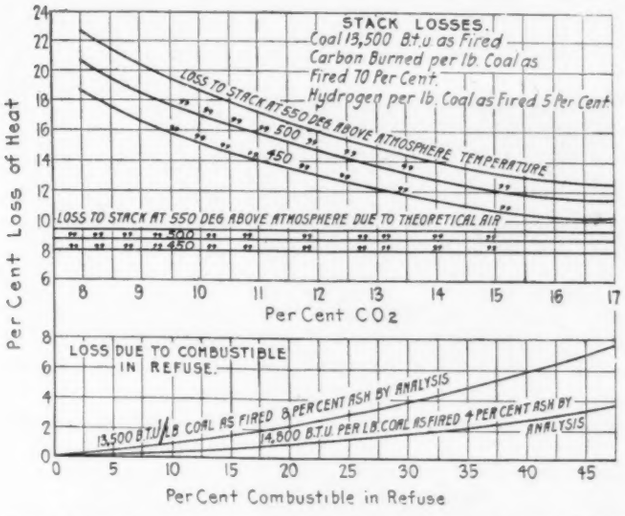
It is highly desirable to standardize the shape and dimensions of the electrodes and the air gap used. The puncture voltage for a given oil will vary with the shape, dimensions and spacing of the electrodes, whether expressed as the puncture voltage for a definite spacing or in volts per mil. Moreover, when testing oil and making a comparison with the manufacturer it simplifies matters where both interests are able to make a direct comparison of results, which is not possible if the electrodes are not the same size and shape and have not the same spacing. Some engineers prefer the disk, others the sphere. The disk is the more easily made, but possesses disadvantages in use. The spherical electrode is less liable to damage from puncture,

the adhesion of foreign particles and air bubbles has less effect and these are less liable to occur. If they do occur they can be more readily removed. The spherical electrode also requires a lower puncture voltage.

BOILER ROOM LOSSES

Effect of Excess Air and Combustible in Refuse on the Economy Obtained in Steam Plants

There are only a few sources of heat loss in a generating plant which can be controlled to any extent, the most important of these being the loss due to excess air. The percentage of heat or percentage of coal which is lost through the stack for different tempera-


STACK LOSSES.
Coal 13,500 B.t.u as Fired
Carbon Burned per lb. Coal as Fired 70 Per Cent.
Hydrogen per lb. Coal as Fired 5 Per Cent.
LOSS TO STACK AT 550 DEG. ABOVE ATMOSPHERE TEMPERATURE
500
450
LOSS TO STACK AT 550 DEG ABOVE ATMOSPHERE DUE TO THEORETICAL AIR
500
450
Per Cent Loss of Heat
Per Cent CO2
LOSS DUE TO COMBUSTIBLE IN REFUSE.
13,500 B.T.U. PER LB. COAL AS FIRED 8 PER CENT ASH BY ANALYSIS
14,500 B.T.U. PER LB. COAL AS FIRED 4 PER CENT ASH BY ANALYSIS
Per Cent Combustible in Refuse

FIGS. 1 AND 2—HOW STACK LOSSES VARY WITH CO_2 AND LOSSES DUE TO COMBUSTIBLE IN ASH

tures of excess gases and percentages of CO_2 is shown in Fig. 1. The straight lines labeled "Loss to stack at 450 deg., 500 deg. and 600 deg. above atmosphere due to theoretical air" show the percentage of coal required for heating the furnace gases from atmospheric temperature up to the stack temperature. With no excess air and perfect combustion these lines represent the heat lost through the stack for various temperatures. With different amounts of excess air indicated by various percentages of CO_2 the total heat loss through the stack is as shown by the upper curves. The differences between the lower curves and the upper curves is the excess air loss.

When interpreting these curves it should be remembered that 16 per cent CO_2 represents 12.4 per cent excess air, 14 per cent CO_2 represents 39 per cent excess air, 10 per cent CO_2 represents 87 per cent excess air, and 8 per cent CO_2 represents 123 per cent excess air. When the CO_2 is reduced from 16 per cent to 10 per cent, the heat loss is increased by approximately 6 per cent of the coal burned, provided, of course, that the exit temperature remains the same. The volume of gases is much greater with 10 per cent CO_2 than with 16 per cent, owing to the greater amount of excess air, and the temperature of combustion is lower; therefore the heat absorbed by the boiler is less, so that the final temperature is higher and the heat loss due to excess air is greater than is really shown by the curves. A difference of 100 deg. in the exit temperature represents a loss of about 2½ per cent.

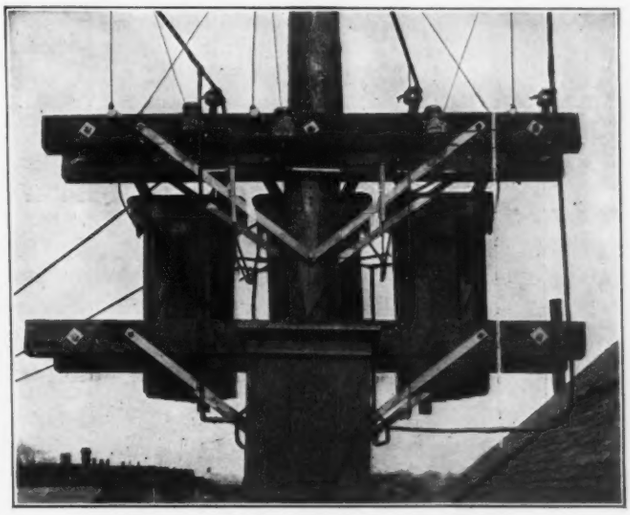
The losses due to combustible in the refuse are shown in Fig. 2. The loss due to the combustible in the refuse in the coal containing 4 per cent ash is approximately only one-half the loss due to combustible in the refuse of the coal burning 8 per cent ash. The curves show it is more important to burn out the carbon in a high-ash coal than a low-ash coal. While this is simple, there is a point beyond which it is not advisable to burn the combustible in the refuse, as large volumes of air are required to burn out the coke to a minimum, and the loss due to excess air greatly exceeds that which would have occurred had the combustible been dumped with the ash. The best plan of operation is to find this point by test or gas analysis and then operate accordingly. These points were brought out by H. F. Lawrence, test engineer of the American Engineering Company, at a recent meeting of the station operation committee of the Ohio Electric Light Association.

IMPROVING LINE WORK

Linemen Criticise One Another's Work by Aid of Photographs of Completed Job

Most of the work carried out by linemen is made in locations which are not readily accessible for inspection, so that careless work cannot readily be detected, especially if reliance is placed upon binoculars alone. On the lines of the Georgia Railway & Power Company, however, the linemen are so interested in their work that they request that photographs be taken of any job of which they are particularly proud. These jobs, naturally, are the more complicated ones and the very kind that ought to be done perfectly. After the photographs are taken they are framed and hung in the trouble stations. Here they are studied by the various linemen, and it is a remarkably good job that gets by unscathed.

In the accompanying illustration is shown a pole-transformer job in which it was found that one lead was



WIRING OF TRANSFORMERS CRITICISED BECAUSE THE LEAD ON THE RIGHT WAS TOO LONG

too long to get a straight wire. T. F. Johnson, superintendent of transmission, finds that self-criticism is more effective than scoldings. The men have simply learned to take such pride in their work that they do everything possible to earn praise instead of blame.

COST OF MANHOLES

Data Based on Analysis of Records from Boston Company Applying to Standard Construction

From an analysis of the cost of distribution equipment on the Boston Edison company's system are taken the accompanying data showing the cost of standard manholes constructed under average conditions during regular working hours without traffic interference or frost. Sewer connections of 15-ft. (4.5 m.) length were provided in all cases.

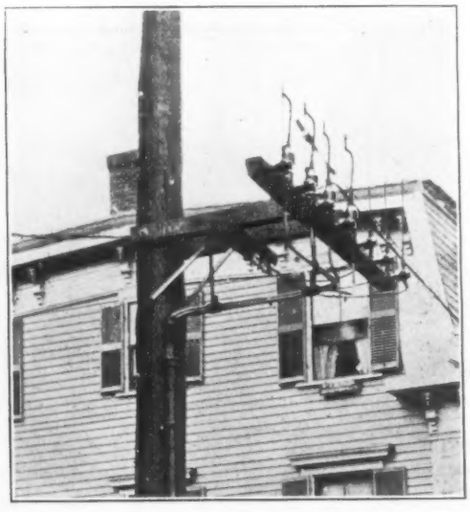
COST OF CONSTRUCTING STANDARD MANHOLES

Approximate Sizes	Surface: Dirt	With Sewer Connection	Surface: Macadam, Ordinary Pavement Without Concrete Base	With Sewer Connection	Surface: Asphalt, Bitulithic, Wood Block, Granite Block, All with Concrete Base	With Sewer Connection
Below 3 ft. x 4 ft. x 4 ft.	$30	$50	$30	$50	$40	$65
3 ft. x 4 ft. x 4 ft.	30	50	50	70	70	95
3 ft. x 5 ft. x 5 ft. or 4 ft. x 4 ft. x 4 ft.	70	90	90	110	110	135
4 ft. x 5 ft. x 6 ft.	80	100	100	120	120	145
5 ft. x 7 ft. x 7 ft. or 5 ft. x 8 ft. x 7 ft. or 6 ft. x 6 ft. x 6 ft. or 7 ft.	125	145	180	200	205	230
6 ft. x 7 ft. x 8 ft.	150	175	200	220	230	255
6 ft. x 10 ft. x 8 ft.	....	....	250	270	285	310

INEXPENSIVE CONSTRUCTION THAT PROTECTS LINEMEN

Method of Supporting Junctions Between Overhead and Underground Lines Where Openwork Wire Extends Part Way Down Pole

The results of an effort to safeguard linemen at junctions between overhead and underground circuits is shown in the accompanying photograph of a type of construction used by an Eastern company. The underground cables are carried from the ducts vertically along the pole to a height of 15 ft. (4.6 m.). The conductors are given a right-angled turn and carried outward about 2 ft. (0.61 m.) below a platform frame to a branching point below an extended cross-arm, the horizontal leads being supported by appropriate insulating hangers. The cross-arm is placed far enough out from the pole to give ample clearance space for a lineman between the wires and the pole itself. From the branching point beneath the cross-arm the various leads are run into small pot-heads, from which taps are made to the overhead lines. All the way up the pole the lineman obtains a clearance of about 18 in. to 24 in. (0.46 m. to 0.61 m.).

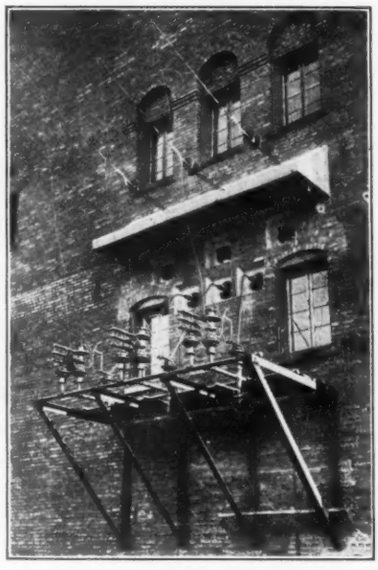


A SPECIAL PLATFORM FRAME USED FOR CONNECTING CABLES TO OVERHEAD LINES

SUBSTATION LINE ENTRANCE

Structure Carrying Lightning-Arrester Horn Gaps Operated from Within Station

In providing for incoming 33,000-volt service the People's Gas & Electric Company of Oswego, N. Y., makes use of the simple but effective structure illustrated herewith. The phase wires are dead-ended on strain insulators fastened to the wall of the building. Taps are carried downward to insulators mounted on a horizontal pipe rod carried beneath a reinforced concrete hood, and thence the wires lead through insulating bushings in the wall to the substation interior. The bushings are surrounded by concrete panels and the inside of the openings in the brickwork is cemented over. The lightning-arrester connections are taken off the taps to the horn gaps and run through bushings to the arresters in the building. The horn gaps are opened and closed mechanically for arrester charging by a rod extending through the substation wall into the interior. This line entrance was built at moderate cost in comparison with the elaborate structures often employed in connection with lines operating at this voltage.



FRAMEWORK SUPPORTING LINE-ENTRANCE ACCESSORIES

Dynamiting Foundations Inside the Station

To make room for the foundation of a 20,000-kw. turbo-generator to be installed shortly in the State Street station of the United Electric Light Company, Springfield, Mass., it has been found necessary to dynamite a foundation of solid concrete already in place for a smaller machine. This work is being successfully done in the turbine-room basement without interrupting service. Blocks of concrete weighing from 1 ton to 3 tons (0.9 t. to 2.7 t.) each are being dislodged by the use of sticks of dynamite 1 in. (2.54 cm.) long, placed in nine or ten holes per block at a depth of about 2 ft. (0.61 m.). The broken-off pieces are removed easily by a Niles electric crane.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

CELEBRATION OF JULY FOURTH

Central Station Can Be of Assistance to Local Authorities Through Many Lighting Effects

In a little more than two weeks this country will celebrate the Fourth of July, the national birthday. This year unusual significance attaches to this day. That the United States of America, which almost a century and a half ago, July 4, 1776, declared its independence and the right of the individual to life, liberty and the pursuit of happiness, should again be waging war for the same rights of the individual makes Independence Day this year doubly dear to the American people.

For that reason an effort greater than usual will probably be made to stimulate patriotism. Bands, parades, decorations, etc., will undoubtedly be used quite extensively. As their share the electric lighting companies can be of great assistance to the local authorities by doing what they can to make the night illumination spectacular. Red, white and blue streamers, floodlighting of statues, searchlights sweeping the skies with color effects, patriotic emblems, electric flags, are some of the ways in which electricity can do its bit.

WOMEN RAISE STANDARDS OF METER DEPARTMENT

Their Presence Is Considered Desirable on Account of Its Effect on the General Deportment of Meter Men and Repair Men

In one of the medium-sized cities of the Middle West the lighting company has built, apart from its other offices, a serviceable and well-arranged building for its meter and distribution departments and has found it advantageous to place a few girls in the clerical division of the force. Both departments were formerly operated wholly by men, with the result that little restraint was exercised by some members of the organization as regarded decency of speech. Time was wasted in story-telling, and the use of lewd language sometimes proved embarrassing to department heads if a customer was visiting the department.

When a vacancy occurred in the clerical force it was decided to fill the place with a girl. A young woman who seemed to possess more than average common sense was selected for the place and was told of the situation as it existed. It was further explained to her that part of the purpose in selecting her for the job was to "quiet down the gang."

The scheme has worked so successfully that the formerly rather rough crew is now a model of deportment. It has been deemed advisable to add still other female employees to the department. One of these, it is expected, will be used in light appliance repair work, which is done on the customers' premises. Incidentally the men now take more pride in their personal appearance as well as in the appearance of the department quarters. The efficiency of both departments has increased perceptibly since the addition of women to the force.

SHALL DEPARTMENT STORES CARRY ELECTRIC RANGES?

Margin of Profit Not Yet Sufficient, but After Pioneer Work Has Been Done These Channels of Distribution Will Be Opened to the Range

A commercial company in a Western state which operates a chain of household-furnishing stores last year did a business in socket appliances amounting to over $200,000. Electric ranges, however, are not sold in any of the stores operated by this company, the reason given being that the margin of profit in the range business is not sufficient to make it profitable as a merchandising venture. The central stations, on the other hand, have largely withdrawn from the socket appliance business, leaving this to the department stores and the electrical dealers. The central station is still selling ranges in the belief that during the pioneer years of the "Cook by wire" idea other agencies cannot do this in a way that will make the ranges "stay sold."

Cause and effect may be interwoven in this situation, because so long as the central station continues to sell ranges without profit on the sale itself other agencies cannot compete. On the other hand, if the department store could sell electric ranges to prospective gas or coal range customers as effectively as it sells socket appliances, the total number of ranges put in service each year would be greatly increased. The department store finds, for example, that many customers come in to look at percolators for use on stoves and go out with electric percolators which were on display among the others, their superior advantages making the sale easy, even at a higher price than the customer expected to pay. A very considerable percentage of the volume of electric appliance business, household-furnishing stores assert, comes from customers who thus compare the electric device with the older type displayed by its side.

VIEW OF THE DEPARTMENT STORE MANAGER

The department store manager is not partial to either type, because he figures a certain percentage of profit on all stock and the customer's choice is immaterial to him. There is this difference, however, that the electric device, being a superior and more elaborate article, usually commands a higher price. Therefore, the total value of goods sold and the total net profit are greater if the percentage of electric appliances sales is high. On this basis the household-furnishing stores can be interested in any new socket appliance that promises to be useful in the home.

The household-furnishing stores handle gas ranges,

and with properly trained salesmen a certain percentage of gas-range "prospects" might well become interested in electric ranges. This becomes the more evident when it develops that a great many gas ranges bring a higher price than the average electric range. Gas ranges costing over $200 are not unusual sales in the larger stores.

Comparing the large household-furnishing stores with the central station as agencies for the sale of electric appliances, other things being equal, it is apparent that the central station desiring to increase this class of load to the utmost will do well to consider a co-operative agreement with the household-furnishing store. The difficulty in effecting such an agreement is the chief obstacle to getting the larger stores in line with other electric range boosters. This, however, should not be insurmountable. It is generally admitted that in time electric ranges will be regularly stocked by household-furnishing stores. Perhaps by further study of the problem this time may be hastened. Manifestly, the central station must undertake to follow up each sale with a demonstrator, guarantee prompt repairs and replacements, etc. The department store, on the other hand, cannot afford to enter into such an agreement unless it has a volume of business that warrants the employment of high-grade electric range salesmen, and these men must keep in close touch with the power companies and understand their problems as well as those of the sales work in which they are engaged.

EFFECT OF INCREASING THE INDUSTRIAL LOAD

Usual Spring Decrease in Output Gives Way to Increase, While Evening Peak Has Practically Disappeared

That the increase in power load has been very great in the last few months and has left an unmistakable impression on the business of central stations is now evident. This condition is briefly commented on, in part as follows, by the Consolidated Gas, Electric Light & Power Company of Baltimore, Md., in a booklet recently issued entitled "A Ten-Year Review, Present Status and Prospects":

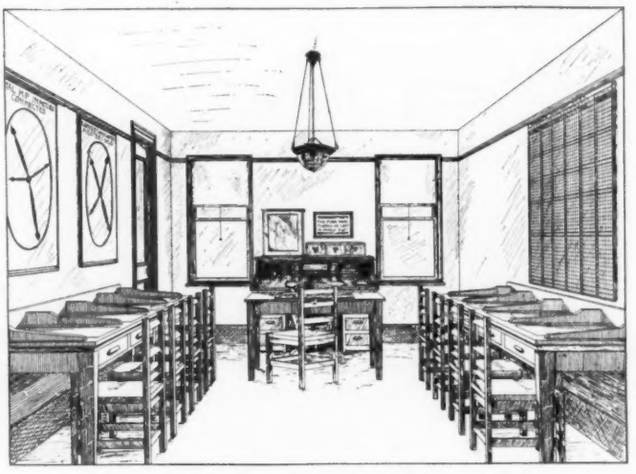
"The conditions are now more favorable than ever before to central station service, owing to increased demand for power and the high cost of coal, supplies, labor and all equipment for isolated power plants. Manufacturers in general have been turning to the electric public service companies to supply their permanent power requirements rather than submit to the delays, uncertainties and unnecessary investment in providing individual power plants, realizing also that both for low cost of power and for reliability central station service is most advantageous.

"Comparing the four months of January, February, March and April, 1917, with the corresponding months of 1916, the average increase in all electric service has amounted to 42.7 per cent, while the average increase in the large industrial service amounts to 65.2 per cent. These four months of 1917 are interesting since they show the continued improvement in the amount and character of electric output. Instead of the usual decrease in output with the spring months, there has been a steady increase from month to month, and evidence of the increasing industrial load is given by the practical disappearance of the evening peak load. The daily output is breaking all previous records even as compared with winter months despite the longer hours of daylight."

MODEL EQUIPMENT FOR COMMERCIAL DEPARTMENTS

All Subsidiary Companies of United Gas & Electric Are Now Equipped with Standard Furnishings and Systems

All of the subsidiary properties of the United Gas & Electric Engineering Corporation now are equipped with standard furnishings and systems for the commercial department. An illustration of such a model department is printed here. On one wall is a sales



MODEL COMMERCIAL DEPARTMENT EQUIPMENT

chart showing the individual records of the salesmen daily during the current month and also the monthly sales for the current year. On the opposite wall are two charts, one showing gas sales and the other the horsepower in motors connected.

TO DEVOTE ADDITIONAL ATTENTION TO APPLIANCES

Byllesby Properties to Campaign Indefinitely Under Belief that Conditions Will Create Big Domestic Demand

Starting immediately and continuing indefinitely, Byllesby electric utility properties will devote additional attention to the placing of electrical appliances in homes. A circular letter to all managers on this subject by Vice-president Arthur S. Huey is quoted:

"High prices for commodities and labor and the drafting of men into the army and primarily essential war occupations are rapidly causing a situation in American households favoring the vastly increased use of electric service for domestic purposes. Practically every electric household device is bound to be in greater demand from now on indefinitely. Scarcity of servants and their dismissal from necessity or economy will cause women of the well-to-do class to turn to mechanical helps to assist them in performing housework. The non-fluctuating character of electric rates will be a factor in causing many people who formerly regarded electric household appliances as luxuries to demand

them as necessities. The cost of service will seem small compared with other increased expense.

"We believe that if proper advantage is taken of the situation a large quantity of electric household appliances can be placed at our properties during the remainder of the year, thus building up the earnings of existing customers and producing additional revenue without increased investment.

"We would suggest that you give the subject of selling electric appliances your very best consideration and call upon the ingenuity and sales ability of your force to promote successful endeavor along this line."

HIGH COST OF LIVING AS ELECTRIC RANGE ARGUMENT

Should Not Be Difficult to Show, Especially in the Case of Large Families, that Saving in Food Will Pay First Cost in One Year

To-day the two things that are most talked of and most thought of are the war and the high cost of living. Every wage earner who has a family to support and every mother who has a family to feed know full well the way in which the buying power of the dollar has decreased. Economy has become a household motto. The problem of the family now is not how little it can get along with, but how that little which the family now has can be stretched out and conserved.

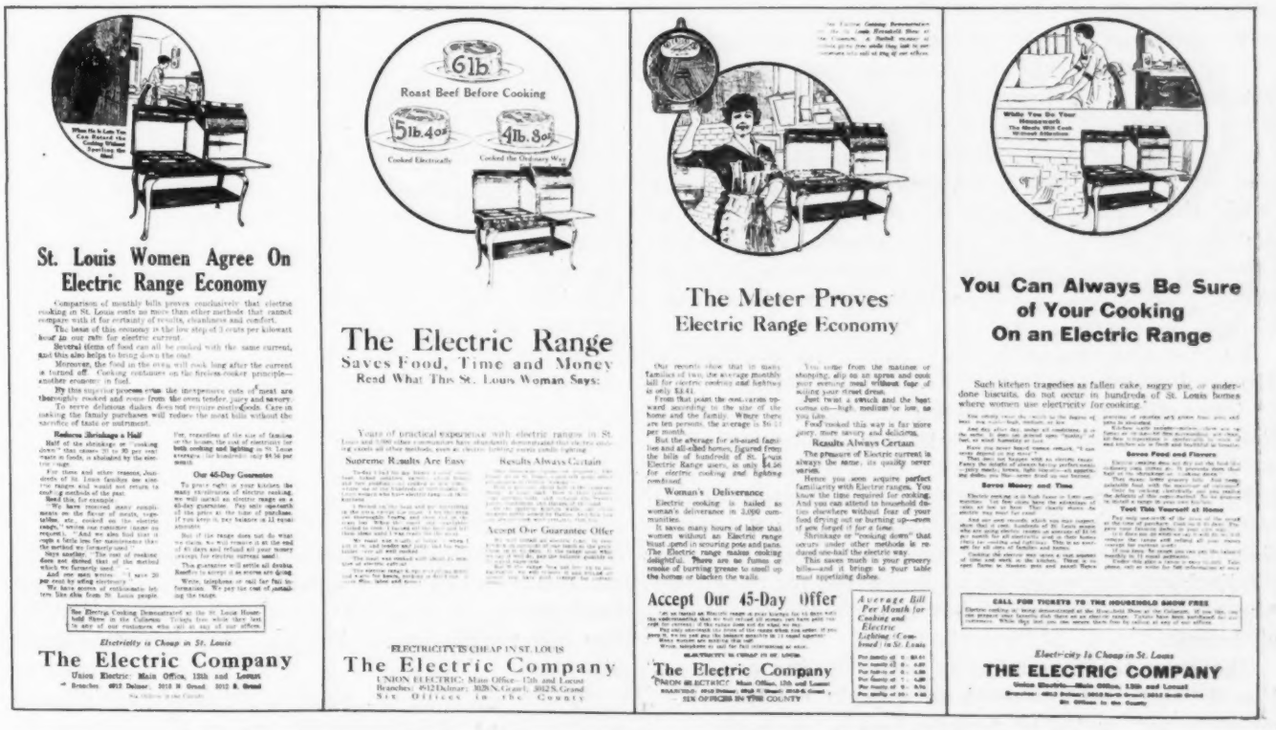
Now is the time when economy will be a greater sales force than ever before; and there seems every reason to believe that the sale of electric ranges will be increased proportionately to the extent that the economy of the range is advertised and used as the selling force behind the advertising.

In St. Louis, where an electric range campaign has now been going on for some months, the Union Electric Light & Power Company has used a series of advertisements in local papers in which emphasis is placed entirely on the economy of the range—economy of food, economy of time and economy of money. The St. Louis company is selling ranges, and selling many of them, and apparently is very successful in its campaign. Some of the advertisements which have been running in the St. Louis papers are reproduced here, and attention is called particularly to the one entitled "Stop Wasting Food—Cook on an Electric Range." Food conservation and electric range economy are clearly shown to be synonymous.

Stop Wasting Food—Cook on an Electric Range
Food Conservation Will Win the War
Read What This Authority Says
FOOD ECONOMY NECESSARY TO WIN, HOOVER DECLARES
Economical of Money
Economical of Foods
Economical of Time
The Electric Company
12th and Locust
6912 Delmar
3028 N. Grand
3912 S. Grand

THE TIMELINESS OF THE ECONOMY ARGUMENT IS APPARENT

It is well known that roasts cooked in an electric range show little loss of weight compared with other forms of cooking. In the present food crisis this is undoubtedly a very strong argument. When a housewife is shown that a 6-lb. roast of beef costing 35 cents a pound will lose only a few ounces during roasting by electricity but over a pound when roasted by other means, a strong appeal is made. It should not be difficult, especially where there are large families, to show that the saving in food at prevailing prices will pay the first cost of the electric range in twelve months' time.


St. Louis Women Agree On Electric Range Economy
The Electric Company
6lb
Roast Beef Before Cooking
5lb. 4oz
Cooked Electrically
4lb. 8oz
Cooked the Ordinary Way
The Electric Range
Saves Food, Time and Money
Read What This St. Louis Woman Says:
Supreme Results Are Easy
Results Always Certain
Accept Our Guarantee Offer
The Electric Company
The Meter Proves
Electric Range Economy
Accept Our 45-Day Offer
The Electric Company
You Can Always Be Sure of Your Cooking On an Electric Range
Electricity Is Cheap in St. Louis
THE ELECTRIC COMPANY

PART OF SERIES OF ADVERTISEMENTS DEVELOPING IDEA OF ECONOMY OF ELECTRIC COOKING

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

USING THE PHOTOELECTRIC CELL AS A PHOTOMETER

Description of a Rapid and Accurate Method Used for Determining Illumination Intensity and Light Distribution

BY JAMES R. RANDOLPH

THE photoelectric cells developed by Dr. Kunz of the physics department of the University of Illinois have been in use for some time for measuring the light of stars, in which service they have given very satisfactory results. It has been suggested that for certain kinds of photometry they would offer advantages over methods now in general use. With a view to determining the suitability of the cells for this kind of work the writer performed the following series of tests in the department of physics, University of Illinois.

FIG. 1—40-VOLT TEST LAMP

Fundamentally, the photoelectric cell consists of a wire grid and a thin film of some metal such as potassium inclosed in a glass bulb containing argon under low pressure. The film is connected to the negative side of the circuit and the grid to the positive side. When light shines on the film it gives off ions which convey small charges of negative electricity to the grid, thus causing a current of sufficient strength to be detected by a sensitive galvanometer or electrometer. The strength of this current has been shown to be directly proportional to the intensity of light reaching the cell for a given quality of light, *i.e.*, inversely proportional to the square of the distance between the source and the cell. This greatly simplifies the calculations and would thus permit the use of the photoelectric cell in photometry where a large number of readings had to be taken, as in determining the distribution of light from lamps, shades, etc., or for determining the distribution of light in a room.

For the test two lamps were used. The first was a 40-volt tungsten lamp (Fig. 1) having a filament made of four coils set in a row so that the light in the direction of the row is much less than that emitted at 90 deg. therefrom. The second lamp was an ordinary 120-watt carbon-filament unit. Distribution curves were made for each of these lamps to show the variation of candlepower around the lamp in a plane perpendicular to its major axis. One curve for each lamp was made with the photoelectric cell and one with a photometer.

The lamp to be tested was placed in the socket *A*, Fig. 2, which was mounted on a graduated revolvable circle sliding on the photometer bench. Near the end of this photometer bench was a box *B*, containing a photometric cell *C* and having a small opening with a shutter in the side toward the lamp through which the light could reach the cell.

The circuit containing the photoelectric cell consists of a battery *D*, whose negative terminal is grounded as shown, while the positive terminal is connected through a 10,000-ohm resistance *F* to the grid, or positive terminal, of the photoelectric cell. The negative terminal of the cell is connected to ground through the graphite resistance *G*, across whose terminals the electrometer *E* is connected. In the circuit supplying the lamp are an ammeter and an adjustable resistance so that the current may be kept constant during a test. For the photometer tests a 16-cp. standard carbon lamp and a Lummer-Brodhun photometer were used.

In starting a test the lamp was lighted and allowed to burn until current through it became constant. Then the lamp was turned until the pointer on the graduated circle stood at zero degrees, when the shutter was opened. After the electrometer deflection was read the shutter was closed until the electrometer indicator rested on zero, when the shutter was opened again and another reading taken. The average of the two readings was used. The shutter was closed, the lamp turned to a new angle, and the process repeated. In this way a series of readings was obtained for different positions of the lamp. To save taking a large number of readings the lamp could be turned by the observer while watching the electrometer. In this way

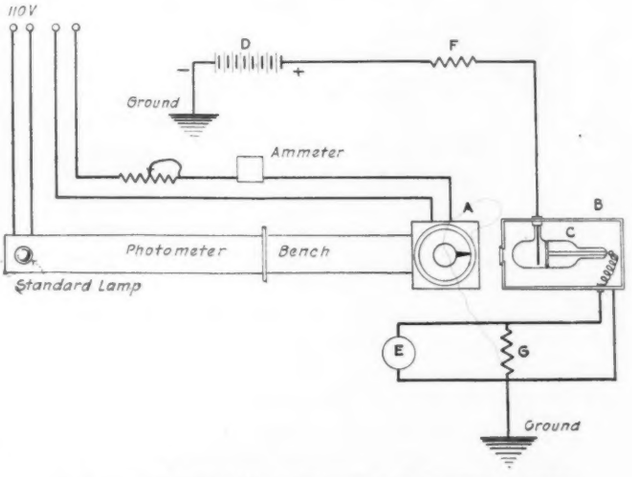


FIG. 2—CIRCUIT ARRANGEMENT FOR TESTING LAMPS

all regions of marked variation can be known in advance and more readings be taken there than in regions known to be uniform. A corresponding set of readings was taken with the photometer, using the same angles as before.

The results of one of these experiments are given in the accompanying curves. By moving the lamp on the

photometer bench light intensities of 4 to 400 candle meters* were secured. The ratios between intensity of illumination and corrected deflection are absolutely constant except for two points at the lower end of the series, and these are not very different. When, therefore, this ratio is known, candlepower can be obtained from deflection by simple multiplication. (The deflection of an electrometer is not exactly proportional to the current, but within the limits of this experiment the error is inappreciable.) To find the ratio for any lamp a number of simultaneous readings of deflection and candlepower are obtained and the average ratio is taken. Since in these experiments photometer readings were taken at all points where cell readings were taken, the average readings could be compared. The curves plainly show the necessity of taking for this purpose several photometer readings at widely separated points in order to get an accurate average. The average values of the light given out in a horizontal plane are identical, no matter whether the photoelectric cell is used or the photometer.

In the curve of the carbon lamp (Fig. 3) there is a hump at 60 deg. for which no reason is apparent. It is probably due to a spot on the lamp bulb where there is less carbon deposit than elsewhere.

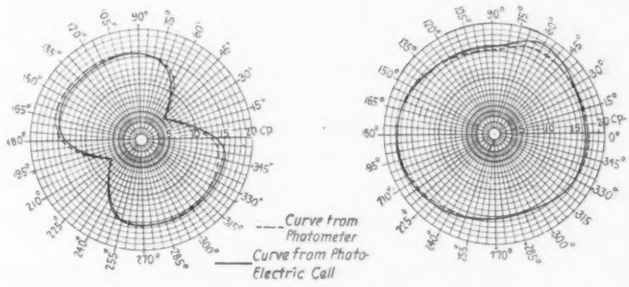


FIG. 3—DISTRIBUTION CURVES OF TUNGSTEN AND CARBON-FILAMENT LAMPS OBTAINED BY PHOTOMETER AND PHOTOELECTRIC CELL

According to these tests it appears that the photoelectric cell in its present state of development can be used as a photometer provided the ratio between candlepower and electrometer deflection is known for the lamp to be tested. It will be especially valuable for cases where a curve must be drawn showing the variation of intensity from point to point, as the readings may be reduced to candlepower by a simple multiplication, and by watching the galvanometer while the cell or the source of light is moved the important points in the curve can be located and the number of readings thus reduced. When large units—for instance, reflectors of high intensity—have to be measured in different directions the space required for an ordinary photometer is very large. The method employing a photoelectric cell and a galvanometer would require only about one-tenth of this space or less.

Generators, Motors and Transformers

Intermittent Rating of Motors of Large Output.—H. H. BROUGHTON.—When the effects of the accelerating, retarding and stopping periods of intermittently loaded motors are considered the three methods commonly used for determining the ratings lead to considerably different results. In view of this condition the author believes that standards committees should specify which method of rating should be adopted.—*London Electrician*, May 4, 1917.

Field Distortion in Direct-Current Machines.—R. W. OWENS.—Relation of compensating windings to commutating poles and consideration of problems of commutation.—*Electric Journal*, May, 1917.

Traction

Operating Results on Electrified Division of Chicago, Milwaukee & St. Paul Railway.—A. BEEUWKES.—Data comparing three months' operation with steam and electric locomotives. Although the figures for electric operation are very favorable they can hardly be considered final, because more experience has been obtained with steam locomotives than with electric. In the period covered about the same number of train-miles were covered with electric locomotives as with steam. The schedule of the through trains under electric operation was reduced forty minutes below that with steam operation. Under these conditions the following results were obtained with steam and electric passenger trains respectively: Excess time in switching cars, 240 and 118; hot bearings (engines), 79 and 641; total minutes delayed, 7198 and 6802; total number of trains delayed, 157 and 81; total number of trains making schedule time, 300 and 307; minutes delayed per 100 train-miles, 6.03 and 5.70; passenger train-miles, 119,330 and 119,-237; coal per train-mile (steam), 188 lb.; kilowatt-hour per train-mile (electric), 29.1. With steam and electric freight trains the results were as follows: Thousand ton-miles per engine, 6745 and 24,260; kilowatt-hours per 1000 ton-miles (electric), 39.4; pounds coal per 1000 ton-miles (steam), 276.—*General Electric Review*, May, 1917.

Electrification of Western End of Chicago, Milwaukee & St. Paul Railway.—K. R. HARE.—Describes the extent of electrification proposed on Chicago, Milwaukee & St. Paul Railway west of Othello, Wash. A description of the system to be used and the method of supplying power is also given.—*General Electric Review*, May, 1917.

Installations, Systems and Appliances

Bombay Hydroelectric Power Scheme.—Descriptive information which supplements that presented by the *Engineer* in its April 16, 1915, issue. The dams which have been built, the article points out, are remarkable for their length, one being 100 ft. (30.5 m.) high and more than 1½ miles (2.4 km.) long. The design features of the dams, aqueduct, headgate, forebay, pipe line, etc., are described and information is given regarding the methods used to overcome construction difficulties.—*London Engineer*, May 18, 1917.

Electrophysics and Magnetism

Electrical Properties of Gases.—J. J. THOMSON.—By experiments it was pointed out that the process of making gases conductive consists of ejecting negative particles from the molecules. This can be done by exposing the gas to the action of radioactive bodies, Roentgen rays, and some other forms of light. The wave length of the light must be less than a certain definite value which depends on the gas used.—*London Engineering*, May 11, 1917.

Electrical Precipitation in Chemical Industries.—A. F. MESTON.—Article calls attention to manner in which

*J. Kunz, *Astrophysical Journal*, March, 1917.

a physicist and electrical engineer can overcome difficulties and improve conditions in chemical industries with electrical precipitation. Applications of this process are referred to in connection with collection of acids driven off during concentration, reclaiming chlorine gas, sulphur and fluorine, precipitation of cement dust, etc.—*The Electric Journal*, June, 1917.

Electrochemistry and Batteries

Characteristics of Electrolyte for Lightning Arresters.—G. C. DILL.—For satisfactory operation of an electrolytic cell, purity of the aluminum and the electrolyte and cleanliness in handling these materials, as well as cleanliness of the container, are very essential, as they affect the characteristics and useful life of the cell. It is believed that a large part of all the troubles which occasionally occur in the operation of electrolytic arresters is due to neglect of one or more of these precautions. Several years ago one of the leading manufacturers furnished the electrolyte in dry form, allowing the customer to mix it with pure water in certain proportions. They were soon obliged to discontinue this procedure, however, on account of the

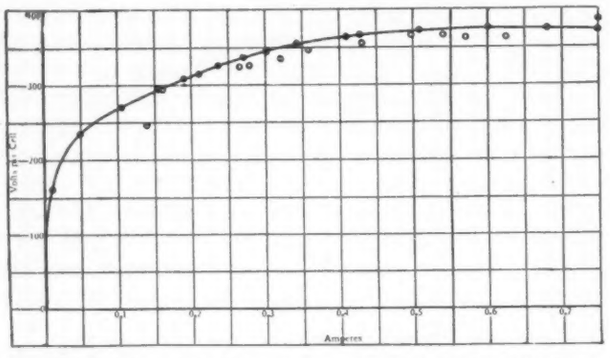


FIG. 4—TYPICAL CHARACTERISTIC CURVE OF ALUMINUM-CELL LIGHTNING ARRESTER WITH IMPURE ELECTROLYTE

unsatisfactory results obtained, because very little reliance could be placed upon the purity of the water used. A remarkable feature of some cells is that the film will build up in less than one-half of a cycle after the cell has stood several days without being charged. Others require a heavy charging current and a long time to build up the film because of poor or an impure electrolyte. The number of cells required for an arrester for operation at a given voltage is dependent upon the critical voltage of the electrolyte which is to be used. Therefore, in arresters of different makes and of different stages of development, electrolytes should not be used interchangeably unless the properties and characteristics of the electrolytes are definitely known. In some cases operators lose sight of the fact that an electrolytic arrester will have a different charging current on 60 cycles from what it will have on 25 cycles. This difference in charging current is due to the capacity effect of the arrester. A large charging current indicates greater electrostatic capacity, which in turn indicates a greater discharge capacity. All electrolytes do not work equally well under the influence of heat. The earlier electrolytes for electrolytic arresters had a maximum safe temperature of approximately 100 deg. The reason for this was that the action of the heat produced certain chemical changes in the electrolyte, which increased the dissolution of the film. Some of the newer electrolytes, however, are comparatively stable under the influence of heat and may be worked up to 135 deg., a temperature which is very seldom exceeded in operating conditions except for very short periods. The chemical constituents of an electrolyte reduce the freezing temperature below that of water, but will not prevent its freezing. Electrolyte for electrolytic arresters freezes between 18 and 25 deg. Fahr., but in the case of lightning arresters it takes a considerable time for the cold to penetrate the surrounding jacket. New developments may bring forth a new electrolyte which will freeze at a still lower temperature. Electrolyte may be subjected to freezing for long intervals without being injured. When frozen its conductivity is reduced, and the freedom of discharge of the arrester is correspondingly reduced. However, the conductivity returns when the electrolyte thaws.—*The Electric Journal*, June, 1917.

Theoretical Aspects of Electrical Precipitation.—W. W. STRONG.—The electrical precipitation process from the theoretical point of view can be divided into (a) the formation of ions, (b) the charging of the fume particles by the ions, (c) the driving of the fume ions to the passive electrode, and (d) the collection of the fume at this electrode. If no ions were formed, if the ions could not be made to stick to the fume particles, or if the fume ions could not be driven to the collecting electrode by the electric field, electrical precipitation of fumes would be impossible. In this paper it is shown how important it is to keep the fumes to be precipitated within the "region of passive electrodes precipitation." The fact that space charges do not interfere with electrical precipitation shows that any choking of corona currents by space charges must be due to the large ions. Through the action of eddies fume particles may be carried within the ion-forming layer. The deposit of a layer of insulating material about the active electrode may result in the piling up of space charges in this region and then sparking. The greater the space charge in a treater the less the voltage that can be impressed upon the treater. An indication is given as to how the charging of fumes can be made more efficient. The great advances in fume precipitation, it was pointed out, will be made by (a) the more efficient charging of the particles, (b) the maintenance of the corona more continuously and uniformly at its maximum value, and (c) the useful applications of the chemical power of the corona as well as its precipitating power.—*Met. and Chem. Engineering*, June 1, 1917.

Telegraphy, Telephony and Signals

New Radio Installation of French Postal and Telegraph Department.—LEON BOUTHILLON.—This paper has for its object an explanation of the considerations which have led the radio service of the French Postal and Telegraph Department to a system wherein a direct-current source charges condensers which are in turn discharged by means of rotary gaps. The investigation shows (1) the theory of the use of direct current in charging radio-telegraphic condenser; (2) the possibility of using such direct-current machines, and (3) the conditions under which such machines can be used and the useful formulas in connection therewith. This work calls attention to high-tension dynamos. It is now possible to build these up to 25,000 volts per machine and even further.—*Proceedings of Amer. Inst. of Radio Eng.*, June, 1917.

Scientific and Industrial Research

A Department Devoted to Interchange of Ideas, Investigations Contemplated, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University

NATION-WIDE CENSUS OF RESEARCH FACILITIES

National Research Council Is Collecting Information to Stimulate Investigational Activity and Co-operation Along Technical Lines

The National Research Council, formed by the National Academy of Sciences at the request of the President of the United States, is collecting information concerning research men and facilities available in this country. Such information will be used to stimulate investigational activity and co-operation along technical lines and to aid in the solution of the scientific and technical problems of the government. While under normal conditions the Research Council will direct its efforts toward the development of research in all its aspects, present conditions demand that special attention be given to the problems of national defense.

An important preliminary step in the work of the Research Council is the preparation of a national census of research, showing the research men and facilities in co-operating government bureaus, educational institutions, research foundations and industrial research laboratories. To secure information for this census in such form that it can be readily tabulated special blanks have been distributed.

Three kinds of blanks have been sent out: (a) for educational institutions, (b) for industrial laboratories, and (c) for institutions other than educational and industrial.

In the blanks sent to educational institutions it is suggested that a research committee be formed in each institution consisting of faculty members, trustees and alumni. Information is asked regarding the available research funds and scholarships, their purpose and limitations as to use. The council also desires a detailed statement as to the ways and the extent to which the personnel and the facilities of the institution might be available for problems relating to national defense. Questions are also asked regarding the extent to which the members are co-operating with each other or with outside investigators, institutions or manufacturers.

Each department is also encouraged to state problems upon which co-operation is desired and the greatest research needs of the staff, such as time for research, funds for special apparatus or materials, library facilities, contact with other investigators, financial aid for attending scientific meetings, leaves of absence to pursue research, etc.

The blanks which were sent to industrial establishments ask for the names and titles of persons who direct research work, the organization of laboratory staff and problems which they are especially fitted to undertake by reason of unusual equipment and trained personnel. In addition, the council asks to what extent the particular laboratory is co-operating with other establishments, and whether or not the council may be of service to it in connection with military problems. As a measure of preparedness, the council desires to know to what extent the facilities of the laboratory may be available for research relating to national defense and how much these facilities could be expanded if necessary.

SCIENTIFIC PROBLEMS ON WHICH RESEARCH COUNCIL IS WORKING

Among subjects that the council is investigating and on which it desires information are the following:

Physics (Dr. R. A. Millikan, chairman).—Exhaustive study of devices for detecting completely submerged submarines and mines; range finders of various types; devices for detecting invisible aircraft and sapping parties; improvements in wireless apparatus and other instruments used with aircraft; military photography.

Chemistry (Dr. Marston T. Bogert, chairman).—Generation, detection and absorption of hydrogen, and problems incidental thereto; absorption of other gases, particularly noxious ones; fire extinguishers; prevention of corrosion and electrolytic action on the hulls of vessels; non-corrosive metals and alloys for a great variety of uses; balloon fabrics; new explosives; new sources of important products; utilization of wastes and by-products.

Engineering (Gano Dunn, chairman).—This committee, which will organize research in the various branches of engineering, has just been formed with the co-operation of the national engineering societies.

Nitrate Supply (Dr. Arthur A. Noyes, chairman).—This committee, which was appointed at the request of the Secretary of War to consider the process to be used by the government in its plant for producing nitrates for explosives and fertilizers, has submitted a full report.

WHAT CANADA IS DOING TO MEET WAR CONDITIONS

Elimination of Waste, Utilization of By-Products and Adoption of New Processes Being Studied in the Dominion

Research has been spurred on in Canada by war necessities, by consideration of Germany's industrial strength and by recognition of the need of co-operation between science and industry. The movement, which is chiefly toward the elimination of waste, utilization of by-products and adoption of new processes, is being directed by the Honorary Advisory Council for Scientific and Industrial Research of the Department of Trade and Commerce.

Closer relations than have existed heretofore are being effected between the educational institutions and manufacturing establishments, so that Canadian college graduates may continue their training in the Dominion under actual commercial practice.

The opportunity for scientific research is to be brought within reach of even the small manufacturing establishment. With this end in view the council has recommended that bureaus be organized in the principal centers of Canada, with technical staffs and properly equipped laboratories.

The advisory council has also grappled with the prob-

lem of providing a cheap fuel for western Canada, more especially for Manitoba and Saskatchewan. Experiments have been conducted with lignite. The council is convinced that from this material two grades of high-class briquetted fuel can be produced, one similar to anthracite and the other to bituminous coal in general character.

Experiments have also been made by officers of the Canadian Geological Survey with oil-laden shale from Lambton County, Ont., with a view to testing its possible value as a fuel. Utilization, too, as a substitute for coal, of peat from the great deposits in northern Ontario and elsewhere in the Dominion has been considered. Exploitation of these potential resources may become an important factor in solving the fuel difficulties of Ontario and Quebec.

N. E. L. A. COMMITTEE SUGGESTS TOPICS FOR RESEARCH WORK

Necessity of Research Along Electrical Lines to Prevent Crippling Industrial Development Is Recognized

Scientific and industrial research has acquired a very great stimulus since the opening of the war. Recognizing this fact, the sub-committee on research of the National Electric Light Association has made an investigation of the possibilities of co-operative research between utilities and institutions having research facilities. As a result of correspondence and conference a large number of problems were suggested the solution of which is of utmost importance to the country at large as on it depends the reliability of electric service furnished industrial plants engaged in the manufacture of the nation's domestic and war-time needs.

A few of the more important subjects are as follows: (1) Fuel economics; (2) characteristics of steel conductors; (3) increasing of load factors by nitrate plants; (4) determination of all combinations of transformer loading, and publication of tables showing their effect on apparatus, both transformer and motor (this will include all emergency conditions, such as conversion of transformer banks from Y to delta and reverse and the effects of lower than normal voltage and also of unbalanced voltages on the operation of motors, and the results of the investigation should be published in tables sufficiently non-technical to be intelligible to power customers as well as of material assistance to central stations in helping their power customers through emergencies); (5) incipient faults in insulators; (6) sludging of transformer oils and determination of their relative values; (7) causes and suppression of surges on long lightly loaded lines; (8) overhead-line and underground-cable insulation for high voltages; (9) protection of lines and equipment against high-voltage, high-frequency, and high-power, low-frequency disturbances; (10) perfection of high-voltage insulators; (11) depths and bearing surfaces of guy anchors in various soils, and (12) inductive interference.

Owing to the postponement of the activities of this sub-committee on account of war activities, educational and industrial institutions which have investigators and laboratory equipment available can do considerable good, this committee points out, if they will undertake the further study of some of these problems.

Summary of Investigations, Available Apparatus and Research Suggestions

Subjects Being Investigated (Research Work Reported Since May 19)*

COMMUTATION.
A critical review of the work already done, including a repetition of the experimental work of Mauduit, and experimental work to explain the apparently contradictory results found by various writers.—*Cornell University, A. Gray.*

CONDENSERS.
Effects of frequencies up to 3000 cycles per second on condensers.—*Ohio State University, A. E. Flowers.*

CORE LOSSES.
Analysis of core losses in rotating electrical machinery.—*Massachusetts Institute of Technology, O. R. Schurig.*

DIELECTRICS.
Study of the laws underlying the dielectric strength of insulating materials.—*Massachusetts Institute of Technology.*

ELECTROMAGNETS.
An experimental study leading to a method of predetermination of characteristics.—*Cornell University, H. W. Brown.*

HEATING OF ELECTRICAL MACHINERY.
A critical review of the work already done, and further experimental work to confirm and to extend the data at present available.—*Cornell University, A. Gray.*

MOTORS, POLYPHASE COMMUTATOR.
Construction of kinematic devices which imitate quantitatively the vectorial relations and give performance characteristics of such motors.—*Cornell University, V. Karapetoff.*

PHOTOMETERS.
Study of integrating photometers.—*Massachusetts Institute of Technology, O. R. Schurig.*

PORCELAIN.
Electrical characteristics of various mixtures and firing temperatures of unglazed porcelain.—*Ohio State University, A. E. Flowers.*

RAILWAYS, ELECTRIC.
Traffic research.—*Massachusetts Institute of Technology, O. R. Schurig.*

RECTIFIERS, ELECTROLYTIC.
An experimental study with the oscillograph to try to improve the efficiency of such apparatus.—*Cornell University, J. F. Putnam.*

SKIN EFFECT.
Researches in connection with conductors at frequencies ranging from 100 to 5000 and from 10,000 to 100,000 cycles per second.—*Massachusetts Institute of Technology, O. R. Schurig.*

TELEPHONES.
Investigation of behavior of telephonic diaphragms.—*Massachusetts Institute of Technology, O. R. Schurig.*

TRANSIENT PHENOMENA.
Mathematical investigation of traveling waves along wires, with the view to introducing trigonometric expressions which simplify the integration of the differential equations and the determination of the terminal conditions. Design of mechanical models to imitate the propagation of impulses along electrical conductors.—*Cornell University, V. Karapetoff.*

TRANSMISSION.
Study of artificial transmission lines; physical qualities of transmission lines.—*Massachusetts Institute of Technology, O. R. Schurig.*

Apparatus Available for Research Purposes

OHIO STATE UNIVERSITY.
(1) Facilities for testing ceramic products; (2) apparatus for investigating high-voltage phenomena using potentials up to 200,000 volts; (3) facilities for tests at telephonic frequencies; (4) two radio sets and two overhead antennae, the larger supplied by a 5-kw. sending outfit.—*A. E. Flowers.*

Suggestions for Research

DIELECTRIC STRENGTH AT TRANSIENT VOLTAGES.
For common dielectrics what are the piercing voltages as functions of time, especially for the short duration of one second to one-thousandth of a second? This information may make clear some obscure points in the operation of lightning arresters, devices for limiting over-voltages, spark protectors, etc.—*Ch. David, Revue Générale de l'Electricité, Vol. I, page 562 (1917).*

INSULATORS.
Improvements in porcelain insulators to increase their life and to reduce cracking; study of substitutes for porcelain; rational theoretical design for dielectric stresses.—*V. Karapetoff, Cornell University.*

REACTANCE FOR ELECTRIC FURNACES.
Investigation of the effect of amount and location of reactance in the circuits for electric furnaces, more particularly in the production of steel.—*T. H. Schoepf, Westinghouse Electric & Manufacturing Company.*

SELF-INDUCTION, EFFECT OF FREQUENCY.
Variation of self-induction with frequency, at radio frequencies. Investigation of this subject was planned by the Ohio State University, but the work has been postponed.—*A. E. Flowers, Ohio State University.*

*The names of individuals given after each institution reporting investigations are those of persons with whom others interested should communicate. All institutions reporting research work should give such names.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

ELECTRIC RATES INCREASED BY THE COLUMBUS COMPANY

Average Advance of 25 Per Cent in Schedules for Both Business Lighting and Power—Residence Rate Unaffected

Electric rates of the Columbus (Ohio) Railway Power & Light Company have been increased to an extent which will average 25 per cent. This change is due to higher costs of operation. No advance was made by the company in the rate for residence lighting; that was already at the maximum figure provided by the city ordinance.

CALIFORNIA TO INTERCONNECT THE TRANSMISSION SYSTEMS

Railroad Commission and Power Companies Discussing Large Plan to Safeguard Service and Facilitate Exchange of Energy

The Railroad Commission of California is discussing with the power companies a plan for interconnecting transmission systems to safeguard service and facilitate an exchange of energy, thereby reducing costly fuel-oil consumption in standby stations. In working out the details of the scheme the engineering committee of the Pacific Coast Section of the National Electric Light Association is assisting with information both as to quantity developed and undeveloped water power available and in the consideration of the problems involved in interconnections.

The Railroad Commission suggests that present action conform to the idea of ultimately having a through bus line from Redding to Fresno, about 300 miles. This would directly connect the large Pit River development now under way with the group of systems in central California and would have sufficient capacity to transfer considerable blocks of energy to or from the Pacific Light & Power Company's Big Creek plant and thus to the southern California group of companies.

Whether or not the State bus plan is carried out it has been shown that meantime the three large systems entering San Francisco can be interconnected so that energy could be interchanged much more effectively than at present. For example, what would constitute a central State bus line could be established by a tie at the junction of the Pacific Gas & Electric Company with the Great Western Power Company midway between Marysville and Sacramento and the construction of 25 miles of line between the Sierra & San Francisco Power Company station at Manteca and the Great Western Company station at Isleton.

This would not only accomplish the ends sought for at present, but would be the logical first move toward the more elaborate interconnection plan if this is adopted later. The high-tension line of the Sierra & San Francisco system passes around the lower end of San Francisco Bay in a loop which would be the logical starting point for connecting the central and southern groups by means of a second or parallel bus passing through and connecting the several companies serving coast cities between San Francisco and Los Angeles.

The commission's proposition had not been formally presented to the companies on June 13, when this information was telegraphed to the ELECTRICAL WORLD, but was already being considered informally and more definite action is expected shortly.

MORE SUBSCRIPTIONS TO THE LIBERTY LOAN

Reports from Various Companies in the Electrical Industries of Investment in the Premier Government Security

As this issue of the ELECTRICAL WORLD goes to press many additional notices of subscriptions to the Liberty Loan from the electrical industries are reported. Among them are:

Consolidated Gas, Electric Light & Power Company, Baltimore, $100,000 for employees in addition to the $100,000 for account of the company itself.

McGraw-Hill Publishing Company, Inc., publisher of ELECTRICAL WORLD, $50,000, representing approximately subscriptions of employees. This is in addition to $100,000 previously reported for the company itself.

OTHER SUBSCRIPTIONS REPORTED

Manhattan Electrical Supply Company, $250,000.

Mackay Companies, $1,000,000.

Crocker-Wheeler Company, $100,000; in addition, $49,800 reported for employees.

Consolidated Gas Company, New York, and affiliated electric and gas companies, $5,000,000; in addition, $700,000 for employees.

Electric Bond & Share Company, $200,000.

American Brass Company, $1,000,000.

Simplex Wire & Cable Company, $100,000.

Westinghouse Lamp Company, Bloomfield, N. J., employees, $30,000.

GENERAL ELECTRIC EMPLOYEES

"Liberty Loan day" at the various plants of the General Electric Company resulted in the sale of $2,955,550 of Liberty bonds. The Schenectady works, with 22,000 employees, the largest plant and the company's main office, led with the total of $1,055,700. Six hundred bond salesmen visited each of the 22,000 employees at Schenectady, and when the last man had subscribed the million-dollar mark was passed. In a number of departments every employee subscribed.

WAR'S INFLUENCE ON CANADIAN CENTRAL STATION DEVELOPMENT

In the First Convention in Three Years Canadian Electrical Association Reflects General Prosperity of Electrical Properties in the Dominion

The twenty-seventh annual meeting of the Canadian Electrical Association, the first convention of this kind since the European war began, was held at the Ritz-Carlton Hotel, Montreal, June 7 and 8. It was very well attended, particularly by engineers and executives of systems in the Eastern Provinces of Canada, and was most encouraging in retrospect and prospect. Mr. D. H. McDougall of the Toronto Power Company, who was recently elected vice-president of the National Electric Light Association, was re-elected president of the association. J. S. Norris, secretary, treasurer and general manager of the Civic Investment & Industrial Company, Montreal, was elected first vice-president; E. A. Dunlop, president of the Pembroke (Ont.) Electric Light Company, was elected second vice-president, and A. Monro Grier of Toronto, vice-president and secretary of the Canadian Niagara Power Company, third vice-president. Alan Sullivan of Toronto was continued as secretary.

CANADIAN PROPERTIES AND THE WAR

In his address President McDougall outlined the difficulties imposed on the Canadian companies by the war and said the industry had passed through perhaps the most eventful year since the founding of the first central station company in 1884. The demands for energy have in most cases been abnormal owing to munition manufacture and to the fact that Canada herself is prosperous, but all the conditions have been met by the companies for the most part in spite of the inroads on operating and commercial staffs, difficulties of financing and of securing fuel. Many companies have had to forego any extensive financing and have had to limit their capital requirements to items of a most imperative nature and which could be financed among shareholders. He showed the extraordinary response to the colors manifested by the entire electrical industry in Canada, stating that both in Montreal and in Toronto about 35 per cent of the normal number of men employed have enlisted.

Mr. George Muldaur, traveling secretary of the National Electric Light Association, brought greetings from the parent body to the Canadian association and showed to what extent the national body has been instrumental in forming an increasing number of company sections.

REPORTS AND PAPERS

Reports were made by Wills MacLachlan of Toronto, chairman of the accident prevention committee; E. N. Hyde, Canadian representative of the Lighting Sales Bureau; M. C. Gilman, Toronto, chairman of the committee on commercial light and power sales; W. H. McIntyre, Ottawa, and L. C. Haskell, Montreal, of the committee on education of salesmen, and P. T. Davies of the Civic Investment & Industrial Company, Montreal, chairman of the rate research committee. In addition, addresses were made by H. E. Howe of Arthur D. Little, Inc., on "Electrochemical Products"; Ward Harrison of the National Lamp Works, Cleveland, on "Illumination"; Julian C. Smith, chief engineer and vice-president of the Shawinigan Water & Power Company, Montreal, on "Energy Distribution, Present and Prospective," and P. Ackerman of the Toronto Power Company on "Selective Relay Protection of Alternating-Current Main Transmission Lines and Distribution Systems." The Montreal companies section of the National Electric Light Association entertained the delegates in the Ritz-Carlton on the evening of June 7.

ENERGY DISTRIBUTION

In his paper Julian C. Smith showed the enormous use made of electricity since 1870. As indicative of electrical development in the Dominion of Canada, Mr. Smith presented the following list showing the kilowatt-hours used per capita as supplied by the electric service companies in the United States and Canada for all purposes except railways:

	Kw.-Hr. per Capita		Kw.-Hr. per Capita
Shawinigan Falls, Que.	41,000	Minneapolis	450
Niagara Falls, N. Y.	33,000	Cleveland	400
Three Rivers, Quebec	3,400	Boston	350
Montreal	700	Philadelphia	250
Toronto	700	New York	225
Buffalo	585	Quebec	200
Pittsburgh	500	Newark	180
Rochester	450		

Mr. Smith intimated that to-day in the United States and Canada, in those places where normal industrial life exists, the kilowatt-hours used per annum per capita amount to about 500, of which 400 kw.-hr. are used for factory purposes and 100 kw.-hr. for household uses. With the increased use of small accessories and development of electric cooking Mr. Smith predicted that the use of electricity in the household will increase 300 per cent within the next five or six years. At the same time the industrial use is bound to increase so that there is every probability that in ten years from to-day the use of electrical energy will be twice what it is at the present time.

While the development of power by means of water-power stations has reached such a high point of efficiency that very little improvement can be hoped for in this direction, Mr. Smith said that the efforts of engineers and designers must be devoted to a reduction of costs and that the financing of such enterprises must also be improved. The government authorities can assist in this matter by preventing duplication of lines and systems and by a proper control of construction work as well as the proper control of rates.

SELECTIVE RELAY PROTECTION

Mr. Ackerman outlined a system of protection on the 60,000-volt lines of the Toronto Power Company between Niagara Falls and Toronto where parallel feeder protection has been in service since January, 1916, and a double-line protection since April, 1917. Both protective schemes have cleared thirty-four line short circuits without a single failure. Ten of the short circuits were due to lightning, four to sleet and wind, fifteen to old insulators, four to line tests made to prove the effectiveness of the relays, and one to some unknown cause. In twenty-six of the cases no load was lost, in five cases less than 20 per cent of the synchronous load was lost, and in three cases the load lost varied from 20 to 50 per cent. The instantaneous selective system used is based in principle on the fact that the currents of the same phase of parallel lines are balanced normally but unbalanced in case of a short circuit within any one of the parallel lines.

ELECTRIC POWER CLUB HOLDS WAR CONVENTION

Eighth Annual Meeting at Washington This Week Divided Between Regular Business and Questions Affecting Service to the Nation

The eighth annual meeting of the Electric Power Club was held at the New Willard Hotel, Washington, D. C., on Monday and Tuesday of this week. The first day's session was given over to the reports of various committees, including standardization, general engineering recommendations, fractional horsepower motors, large power motor, direct-current generator, transformer section and industrial control section. Most of the reports merely outlined the progress made by the committees since the last meeting.

In order to meet government and other similar requirements regarding name-plate markings, the general engineering recommendations committee has suggested that where the name-plate clearly indicates the specifications to which the apparatus conforms it is not necessary to give the detailed information specified in the rules of the club. The fractional horsepower committee recommended that the following name-plate markings be adopted as standard for fractional horsepower motors: For direct-current motors, (a) manufacturers' type and frame designation, (b) horsepower output, (c) time rating, (d) temperature rise, (e) r.p.m. at full load, (f) voltage, (g) full-load amperes, (h) winding, shunt, compound or series; for alternating-current motors, (a) manufacturers' type and frame designation, (b) horsepower output, (c) time rating, (d) temperature rise, (e) r.p.m. at full load, (f) frequency, (g) number of phases, (h) voltage, (i) full-load amperes.

On Tuesday morning the club listened to addresses by members of the Council of National Defense and by representatives of the government on the needs of its electrical division and correlative matters of specifications and tests. In the absence of Howard E. Coffin, W. S. Gifford outlined the work of the Council of National Defense and Paymaster John M. Hancock, officer in charge of purchase division of the Bureau of Supplies and Accounts, Lieut. Alexander Sharp of the electrical division of the Bureau of Steam Engineering and Mr. Dean, electrical expert of the Bureau of Construction and Repair, spoke of the methods of these various navy departments in filling their electrical needs.

STANDARDIZED COST SYSTEM

The chief topic of discussion of the whole meeting centered around the address of C. E. Patterson of the General Electric Company on uniform accounting. The accounting and cost system which is recommended for adoption by electrical manufacturers has the indorsement of the Electrical Manufacturers' Club, the Electric Power Club and the Associated Manufacturers of Electrical Supplies. It moreover bears the indorsement of the Federal Trade Commission. This system has been so planned that it not only conforms to the requirements of scientific accounting and an adequate cost system but is sufficiently flexible to be used to advantage by both large and small manufacturers.

The discussion was led by J. Lee Nicholson, a leader in the specialized branch of cost accounting, who has recently joined the Bureau of Foreign and Domestic Commerce to take charge of this branch of its work. It will be remembered that the Bureau of Foreign and Domestic Commerce has taken over from the Federal Trade Commission all matters relating to uniform cost accounting. It was recommended that all members of the Electric Power Club place the accounting and cost system into effect at once and give the committee as a result of its application to standard practice such suggestions for modification in minor details as would improve it. In view of the various measures adopted by the government for taxing manufacturers it was very generally recognized that an accurate knowledge of costs, depreciation, etc., was highly essential.

The government being prepared to let contracts on a cost plus percentage basis, it is now at work determining the elements constituting cost. Mr. Patterson was appointed to represent the club to aid the government in arriving at a just basis of cost.

At the Tuesday afternoon's session a very instructive paper was read on "Analysis of Increased Cost in Manufacturing Conditions" during the past three years. This showed the upward trend of prices of all material used in the manufacture of motors. There was also an interesting discussion on national economy. It was recognized that funds to meet the requirements of present and future government war loans must be derived as far as possible from savings from decreased expenses, and a paper was read outlining how manufacturers of electrical apparatus might further national economy during the war by limiting advertising, exhibition and entertainment expense where results are dubious. It was recommended that advertising be limited to journals with a high editorial standard.

E. R. Harding, the president of the club, owing to the condition of his health tendered his resignation as president and C. L. Collens, 2d, the vice-president, was elected in his stead. F. S. Hunting of Fort Wayne, Ind., was elected vice-president and T. E. Barnum of Milwaukee was elected to the board of governors. C. H. Roth of Chicago continues as secretary and treasurer. There were no other changes in the board of governors, which now consists of the president, vice-president, secretary and treasurer in addition to the following: James Burke, Burke Electric Company, Erie, Pa.; J. C. Hobart, Triumph Electric Company, Cincinnati, Ohio; J. R. Jeffrey, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.; T. E. Barnum, Cutler-Hammer Manufacturing Company, Milwaukee, Wis.; W. A. Layman, Wagner Electric Manufacturing Company, St. Louis, Mo.; S. L. Nicholson, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; H. C. Petty, Crocker-Wheeler Company, Ampere, N. J., and R. J. Russell, Century Electric Company, St. Louis, Mo.

C. L. Collens, 2d, who has been elected president of the club is a graduate of the Sheffield Scientific School of Yale University and of the School of Mines, Columbia University, having received a degree of electrical engineer from the latter in 1897. Following his graduation he spent a number of years at Niagara Falls as general manager of the International Acheson Graphite Company and later as superintendent of the plant of the Canadian Niagara Falls Power Company. For the last nine years Mr. Collens has been president of the Reliance Electric & Engineering Company of Cleveland, Ohio.

MOBILIZATION OF THE ELECTRIC AND GAS SERVICE

National Committee, of Which John W. Lieb Is Chairman, Issues Statement of Organization—Ready to Serve the Nation

The following statement has been issued by the National Committee on Gas and Electric Service, of which John W. Lieb is chairman:

Some months ago the committee of the American Gas Institute to co-operate with the government in regard to the military needs of the nation and the committee of the National Electric Light Association on war conditions, at a joint conference held in New York City, decided to organize a national committee which would secure to the United States government the most effective co-operation in the conduct of the war from the gas and electric light and power industries. The National Committee on Gas and Electric Service was thereupon organized with a membership of representative men from these two industries and the related natural-gas industry. The committee, as constituted, is as follows: Walter R. Addicks, vice-president Consolidated Gas Company, New York; Philip P. Barton, vice-president Niagara Falls Power Company; John A. Britton, vice-president Pacific Gas & Electric Company; Alex Dow, president Detroit Edison Company; Charles L. Edgar, president Edison Electric Illuminating Company, Boston; A. E. Forstall, president American Gas Institute; Joseph F. Guffey, president Natural Gas Association of America; Samuel Insull, president Commonwealth Edison Company; Chicago; D. C. Jackson, professor of electrical engineering, Massachusetts Institute of Technology; Joseph B. McCall, president Philadelphia Electric Company; Capt. William E. McKay, vice-president New England Gas & Coke Company, Boston; Herbert A. Wagner, president Consolidated Gas, Electric Light & Power Company, Baltimore; S. S. Wyer, consulting engineer, natural gas industry, Columbus; John W. Lieb, vice-president New York Edison Company (chairman of committee); William H. Gartley, vice-president Equitable Illuminating Gas Light Company, Philadelphia (vice-chairman of committee); George W. Elliott (secretary of committee), Washington.

RECOGNIZED AS ADVISORY COMMITTEE

The committee is recognized by the advisory commission of the Council of National Defense as one of its advisory committees, and it has established an official headquarters in the Munsey Building, Washington, D. C., where it has placed itself at the service of the government for any assistance it may be able to render in behalf of the public utility industries it represents.

It is prepared to act as a vehicle of communication in all matters relating to the national defense between the various instrumentalities organized by the governmen for the conduct of the war and the gas companies producing and distributing artificial and natural gas and the electric light and power companies furnishing electric service. It proposes to place promptly at the disposal of the government any data or information which it may require as to the facilities in men or service which the companies may have available, to insure the continuous operation of plants so as to enable the munition plants, navy yards and manufacturing establishments, through continuous and uninterrupted service, to maintain their maximum output, and it will endeavor to provide the government with the necessary quantity of the essential by-products that can be made available for the production of high explosives and ammunition.

One of the most essential requirements in the co-ordination of the industrial resources of the country for the successful conduct of the war is to provide a regular and adequate supply of fuel to the important utilities engaged in enterprises through which they render service to the government and to the public. To facilitate solving the many problems affecting the continuous supply of fuel to operate their plants, the National Coal Board has been pleased to appoint George W. Elliott, secretary of the committee, to membership on the coal committee.

A questionnaire is now being prepared which will within the next few days be forwarded to every gas and electric light and power company in the country, asking them to send a statement of the various kinds and quantities of fuel each uses per annum for its various purposes, the water or rail connections over which they are received, together with a monthly statement of fuel contracted for, received and consumed. This will enable the committee to give prompt information to the authorities of fuel shortage in any particular locality, with the transportation lines involved, loading and unloading delays, car shortages, routing and transshipment difficulties, etc.

OPPORTUNITIES FOR CO-OPERATION

The committee has been in consultation with the authorities on matters affecting the service which the employees of the companies may render to the government and in regard to various questions connected with selective registration, conscription exemptions and provision for the dependents of employees who may be called upon to render military service. The furnishing of heat, light and power service to the troop cantonments for the mobilization of the military forces located in different parts of the country is now being considered, and information is being collected as to how these agencies may be made available to the camps in the shortest possible time from the nearest points of supply.

It is believed that this National Committee on Gas and Electric Service can be of great assistance to the government in these several directions and that it will cover a broad field of useful and patriotic service, bringing to bear on the successful conduct of the war, from the standpoint of efficient industrial mobilization, the vast resources of men and facilities which the utility companies of the country have at their command and through which they are now efficiently serving the public and which they desire to make available to the nation to the greatest practicable extent.

NEW YORK EDISON ASKS RELIEF FROM RATE CUTS

Tentative Promise of Further Decrease on July 1 Was Subject to Business Conditions—Increased Costs Heavy

The New York Edison Company has asked the Public Service Commission, First District, not to enforce against it a tentative promise which it made last November to reduce rates on July 1. The request was made by J. W. Lieb, vice-president and general manager.

The company at this time does not, according to Mr. Lieb, intend to go back to the old rate of 8 cents, but it desires in the face of cost increases already encountered and others expected in the near future to retain the 7½-cent rate for the present.

Mr. Lieb was requested by the commission to furnish detailed information as to the net increases in income in new business acquired and as to the added and expected increases in cost of production and distribution. Not having these figures at hand, Mr. Lieb requested an adjournment, which was taken until June 20.

Mr. Lieb said that the increase in the cost of coal alone is 50 per cent more than was contemplated at the time reductions were proposed. He added that the increased costs of the last four months represented a minimum of the increased costs expected. One new cost not contemplated is the 340 men who have been specially hired as uniformed guards to watch the plants of the company at a cost of about $400,000 per year.

"NORMAL PROFITS OF BUSINESS SHOULD BE MAINTAINED"

E. N. Hurley Says that Without Fair Margin of Return on Capital and Labor Necessary Incentive Will Be Lacking

Edward N. Hurley, former chairman of the Federal Trade Commission, in an address before the World Salesmanship Congress, Detroit, on "The War and Business," said in part:

"Shortly there will be created in Washington a central purchasing commission for the United States government and its allies. If this agency provides a uniform system for purchases, such as the cost of production plus a reasonable profit, the basis will be established for sound business conditions throughout the nation.

"It is idle to talk about cutting the profit out of war. There should be no abnormal profits, but the normal profits of business should be maintained, because without such a fair margin of return on capital and labor there will be none of the incentive necessary for increased productive energy.

"We should be able to meet the war bills out of our surplus energy. This is the best contribution that business men can make. There is no need for disturbing any wage or hour standard. If a man works eight hours a day, let him put a little more heart into his task and he will find that his productive energy will increase materially. Let the business man conduct his business a little more vigorously; let him work out his cost sheets and get his prices where they ought to be, and he will find that he is making enough extra money to pay for taxes and Liberty bonds. That should be his share in the war."

CITY OF CLEVELAND REPORT ADVISES BUYING COAL LAND

Commissioner Davis Also Suggests Direct Purchase of Fuel and Cars and Arrangement for Generating at Mouth of Pit

W. E. Davis, Commissioner of Light and Heat of Cleveland, recommends to the Director of Public Utilities an investigation of the possibilities of acquiring a comprehensive area of coal-bearing land. He recommends that for immediate requirements coal be purchased at coal mines through reputable agents at prices based upon miners' scale of wages and the heating value of the coal, with a reasonable profit for the producer. He also suggests purchase of a number of modern coal cars to transport fuel, installation of a submerged storage pit to hold at least 20,000 tons, and that every possible encouragement be given to some concern or corporation to establish a generating plant at a coal mine to transmit energy to the city.

The report takes up the possibility of combination of a number of cities to build a generating plant and buy a coal mine. Cleveland is faced with coal problems which make necessary the expenditure annually of upward of $438,000 in excess coal prices. The commissioner expresses the belief that the new Windsor plant of the American Gas & Electric Company will be able to produce energy at the switchboard for 1.5 mills per kilowatt-hour if not less. Application was made to the American Gas & Electric Company for a block of this power for Cleveland, but the commissioner was informed that the entire output had been sold. Construction of a power plant at a mine by the city itself, the commissioner says, is not practicable at present on account of the abnormal and unreasonable prices. However, it must be seriously considered, he said, in the near future.

LARGE-SCALE PRODUCTION NOW DESIRED IN ENGLAND

Board of Trade Committee Reports that Comprehensive Generating System Should Be Established as Soon as Possible

A memorandum has been issued by the electric power supply committee which was appointed by the Board of Trade of London, England, to "consider and report what steps should be taken, whether by legislation or otherwise, to insure that there shall be an adequate and economical supply of electric power for all classes of consumers in the United Kingdom, particularly industries which depend upon a cheap supply of power for their development."

The committee has unanimously concluded:

1. That when British industry is subjected to the test of keen international competition, after the war, its success will depend upon the adoption of the most efficient methods and machinery so as to reduce manufacturing costs as much as possible.
2. That a highly important element in reducing manufacturing costs will be the general extension of the use of electric power supplied at the lowest possible price, and it is by largely increasing the amount of power used in industry that the average output per head, and as a consequence the wages of the worker, can be raised.
3. That the present system under which a supply of electricity is provided in a large number of small areas by separate authorities is the result of a policy adopted at a time when the applied science of electrical engineering was in its infancy, and is incompatible with anything that can now be accepted as a technically sound system.
4. That the interconnection of existing electric supply stations recommended by the Board of Trade in its letter of May 25, 1916, however desirable in itself, cannot alone meet the requirements of the situation.
5. That a comprehensive system for the generation of electricity, and where necessary reorganizing its supply, should be established as soon as possible.

Representative associations will be invited to give evidence as to the best methods of giving effect to the conclusions.

NEW YORK OFFICE MOVED BY GENERAL ELECTRIC COMPANY

Change of Location from 30 Church Street to New Equitable Building Made on Twenty-fifth Anniversary

The New York City offices of the General Electric Company will be moved on June 16, the twenty-fifth anniversary of the company, from 30 Church Street to the Equitable Building, 120 Broadway. The entire twentieth floor has been arranged and furnished for the company. For nine years the offices have been at 30 Church Street, where the company located its New York headquarters when it outgrew the "Edison Building," at 44 Broad Street. This building was originally built for the Edison General Electric Company.

N. E. L. A. PUBLIC POLICY COMMITTEE MEETING HELD

Report Presented by Chairman Lieb of the Committee on War Conditions—Service for Cantonment Camps

A meeting of the public policy committee of the National Electric Light Association was held at the headquarters in New York on June 8.

A number of matters were discussed. John W. Lieb, chairman of the committee on war conditions, presented a report outlining the work done by the National Committee on Gas and Electric Service. A similar report of the national committee, of which Mr. Lieb is also chairman, is published elsewhere in this issue.

It was also reported by Mr. Lieb that the government had asked for information as to the possibilities of furnishing electric service for the army cantonment camps. Information obtained from the various companies has been forwarded to Washington. Similar information regarding gas service was also furnished.

ORNAMENTAL LIGHTING FOR LOS ANGELES, CAL.

Careful Consideration Given to Standards for Broadway District in Order to Enhance Daylight Appearance of Street

A new ornamental lighting system is proposed for the district on Broadway, Los Angeles, between the Broadway tunnel and Tenth Street. The work is being undertaken by the Broadway Improvement Association. Total installation cost will be about $85,000, of

TYPES OF STREET-LIGHTING STANDARD FAVORED IN LOS ANGELES

which one-half or more will be paid by property owners and the remainder by the company supplying the service. The system was designed by W. D'Arcy Ryan, General Electric Company.

A resolution giving special commendation to the members of the Improvement association for their energy and the results accomplished, despite the cry of "retrenchment" on account of the war, was passed by the City Council of Los Angeles.

In general the scheme is to replace the present incandescent clusters with more ornamental and higher standards each carrying two luminous arc lamps of high candlepower, thus increasing the light flux in the street six or seven times, with an increase of less than two and one-third times the operating cost. Careful consideration has been given to the design of the standard in order that the daylight appearance of the street may be greatly enhanced and the row of standards may be a unifying factor of the street.

WESTINGHOUSE CHANGES AFFECT ELECTRICAL MARKETS OF WORLD

British Company Control Shifted to England, but American Company Retains Minority Interest—Alliance to Rival German Interests

Publication in the London newspapers of news of the sale of holdings of the Westinghouse Electric & Manufacturing Company in the British Westinghouse Electric & Manufacturing Company, Ltd., and an interview given out subsequently by Chairman Guy E. Tripp in New York confirm the rumors that final steps have been taken in the organization of a great aggregation of Westinghouse electric interests. A powerful financial group in London, through the control of the British Westinghouse Company, the French Westinghouse Company and the Italian Westinghouse Company, are said to have further plans which will rival the great German company, the Allgemeine Electricitäts Gesellschaft.

It is significant that the American Westinghouse company not only retains a financial interest in this combination, but that the sale of its shares is based upon and made in connection with an agreement of alliance with the London group under which the American company trades in the Western Hemisphere and the Far East, including Asiatic Russia, and the British company in Europe, Africa and Australia, each company representing the other as sole agent in its respective territory for business that naturally gravitates toward the other.

This is especially interesting as it is the first great Allied business combination that has been announced since the beginning of the war and marks another important development in the affairs of the Westinghouse company.

In his statement confirming the London report of a change in the relations of the American and British companies, Mr. Tripp said:

"The whole transaction is based upon an agreement under which the interests of the British company and the American company become closely allied to the end that the engineering skill and organization of both companies shall be most effectively put to use in the markets of the world."

In a letter to shareholders the directors of the British company say that "in view of the sentiment produced in this country by the war and of the possible changes which may result in international economic relations," they have desired for some time that the control should be transferred to Great Britain. They are of the opinion "that it is for the advantage of your company that our American friends should retain such an interest in its profits as will make it worth their while to continue in the future to assist in its development."

WORK OF N. E. L. A. SECTIONS MODIFIED IN THE WAR YEAR

Chairmen McClelland, Mansfield and Edkins Show that the Sections Are Meeting the Exigencies of War

While the work of sections of the National Electric Light Association cannot be forecast definitely because of the uncertainty of the war, the chairmen are following the policies formulated by the annual meeting on May 9 and 10.

TECHNICAL AND HYDROELECTRIC SECTION

R. J. McClelland, chairman Technical and Hydroelectric Section, writes to the ELECTRICAL WORLD:

"The Technical and Hydroelectric Section does not contemplate any considerable modification either in the character or in the extent of its activities.

"It was the opinion of the annual meeting that all important committee work should be continued with no more curtailment than would inevitably be necessitated by the increased individual responsibilities of the committee members. The member companies of the association are to be urged to make available as heretofore, in so far as they are able, the needed time of the members of their organizations.

"The technical committees have done some exceptionally valuable work during the last year, in spite of the severe handicap imposed by the unusual individual demands upon the men who have been carrying it on. It is most important that this work continue. If it possesses value in time of peace, its value should be greater now. The adjustments to changed conditions, the improvements in general efficiency which we will be called upon to make, will be much aided by the opportunities which this committee work affords for making generally available the results of individual experience."

ELECTRIC VEHICLE SECTION

E. S. Mansfield, chairman of the Electric Vehicle Section, writes to the ELECTRICAL WORLD:

"The Electric Vehicle Section has followed certain lines of specific endeavor during the past year rather than spending its time in general work and has exerted a great deal of influence and accomplished a good deal through its various committees in pushing along the business, which has been very successful and very gratifying.

"During the coming year, although the activities may be somewhat modified, it will be the intention of those directing the section to continue all activities to as great a degree as possible consistent with the necessary curtailment on account of the national conditions, and conforming to the general policy which may be defined for carrying out the work by the N. E. L. A."

COMMERCIAL SECTION

E. A. Edkins, chairman of the Commercial Section of the National Electric Light Association, has made the following statement in regard to the activities of the section during the coming year:

"To summarize adequately the vast amount of practical and valuable work accomplished by the Commercial Section during the last administrative year would require more space than is now available. The work of the Commercial Section as at present conducted enters minutely and exhaustively into every detail connected with the commercial side of our industry and, by cross-membership with other sections, into all related activities in which commercial work is at all concerned with the technical and accounting side of the business. This work is performed cheerfully and gratuitously by busy men occupying responsible positions in their respective companies, whose services in this work are given at a considerable personal sacrifice.

"Under the new and changed conditions this work will be continued, even though the necessary personal sacrifices may be greater than ever before. In general, the policy of the Commercial Section, at least for the immediate future, will be to watch with greater care than ever the developments in commercial work in all sections of the country, to study the best methods for developing intensive business to go on existing lines, to be on the alert for any and all opportunities which may present themselves for effective co-operation with the association staff at headquarters and with other association committees, and to hold ourselves in readiness to assume any new burdens or duties which may be assigned to us by the incoming administration."

SUBSTANTIAL IMPROVEMENT IN NORTH AMERICAN REPORT

President Mortimer, in Twenty-seventh Annual Statement of Holding Company, Shows Conditions in the Wisconsin and Missouri Subsidiaries

President James D. Mortimer of the North American Company, in the twenty-seventh annual report to stockholders, said that business conditions in the territories in which the company is interested showed substantial improvement over those prevailing during the greater part of 1915. This is readily apparent in the increased earnings of the Wisconsin subsidiaries. Some improvement in industrial activities in the Missouri territory is reflected in increased operating revenues, though offset in large measure, Mr. Mortimer adds, by increased operating expenses, due to higher costs of material, fuel, labor and taxes.

Total income of the company was $2,304,329, as compared with $1,952,503 in 1915. Dividends aggregating 5 per cent were paid on the stock.

A committee of the directors revalued the securities. The report states that conservative valuations were placed on all the securities; the amount at which 184,000 shares of United Railways Company of St. Louis common stock was carried was reduced to $1. The net decrease in book values was $2,600,000, which was charged to "contingent security depreciation reserve," created in 1914, leaving a balance in that reserve of $50,000.

Worcester Company's Steam-Heating Rates

The ELECTRICAL WORLD is requested to state, in correction of a misquotation in a former issue, that the following are the correct steam-heating rates of the Worcester (Mass.) Electric Light Company: First 10,000 lb., 95 cents per 1000 lb.; next 10,000 lb., 85 cents; next 30,000 lb., 75 cents; next 60,000 lb., 65 cents; next 120,000 lb., 55 cents.; all over 230,000 lb., 45 cents. The average rate received by the company is about 50 cents per 1000 lb.

RATE INCREASE BY A MUNICIPAL PLANT

Lighting System of Taunton, Mass., Raises Rates to Consumers to Keep Step with Advances in Cost of Coal

The municipal lighting plant at Taunton, Mass., has increased rates on account of higher coal cost.

Beginning July 1, the power schedule will be increased 5 per cent and the commercial lighting schedule 2½ per cent, these applying in both classes for each advance of $1 in the price of coal above $5 per gross ton.

OHIO COMMISSION AUTHORIZES INCREASE IN POWER RATES

Northwestern Ohio Railway & Power Company Raises Wholesale and Retail Power Schedule Practically 33 1/3 Per Cent

The Ohio Public Utilities Commission of Ohio has granted authority to the Northwestern Ohio Railway & Power Company to increase wholesale and retail power rates practically 33 1-3 per cent. The rates are to be covered by a tariff and approved by the commission on the usual thirty-day statutory notice. This will make the new rates effective on Aug. 1.

The company is controlled by the General Gas & Electric Company. It sells energy to the Port Clinton Electric Light & Power Company, also controlled by the General company. It also lights Genoa, Lakeside, Curtice, Clay Center and Gypsum.

RECOMMEND CHANGES IN NIAGARA SITUATION

Pending Legislation Under Discussion at the National and New York State Capitals Affecting the Production of Power

Electrochemical industries along the American-Niagara frontier are vitally interested in the bill advocated by Secretary of War Baker which seeks unusual rights regarding the extension of water-power diversion permits at Niagara Falls, N. Y. Explaining the measure before the House foreign affairs committee, Secretary Baker declared that he would not only designate who should enjoy the use of the extra diversion of water from the Niagara River but would regulate the price of the products that are manufactured with that power.

Gen. William M. Black, chief of engineers, mentioned that a survey is being made for a canal around Niagara Falls which might be used as a power project as well as for navigation. For several months federal engineers have been investigating the Niagara power situation as applied to the electrochemical industries, whose products are in great demand for the government. The shortage of power has handicapped many large and important industries.

Representatives of the large electric generating and electrochemical industries of Niagara Falls, N. Y., appeared recently before the New York State Conservation Commission at Albany in reference to the Niagara power situation. The generating companies explained the urgent necessity for legislation which would tend to increase the efficiency of existing power companies on the American side of the river and the increasing demands for additional electric power. It was pointed out that of the two companies on the American side of the river one diverts 6500 cu. ft. (182 cu. m.) of water per second and the other 8600 cu. ft. (241 cu. m.). One drops the water 138 ft. (42.06 m.) and develops 11 hp., and the other drops it 214 ft. (65.2 m.) and develops 22 hp. It is the object of the two companies to run the water through a single tunnel, thus gaining increased efficiency and developing greater horsepower.

Among those at the conference, which was held in the office of George D. Pratt, conservation commissioner, were Frederick D. Corey, president of the Niagara, Lockport & Ontario Power Company; Morris Cohn, Jr., of the Hydraulic Power Company, and former Senator Clinton T. Horton, attorney for Mr. Corey.

NEW HAMPSHIRE COSTS LEAD TO HIGHER RATES

Concord Company, Receiving Authority to Acquire Another Property, Shows Increased Costs from 21 Per Cent to 285 Per Cent

Higher local rates and improved service resulting from a proposed consolidation were under consideration by the New Hampshire Public Service Commission, following the petition of the Concord Electric Company for authority to purchase the Penacook Electric Company. On behalf of the Concord company Levin J. Chase, local manager for Charles H. Tenney & Company of Boston, general managers of the system, testified on costs.

Evidence showed that the application of the Concord rates to the Penacook customers would increase bills of the latter about 18 per cent, but that service would be greatly improved.

Mr. Chase presented the following, showing increases in cost since 1914:

	Old Cost	Present Cost	Per Cent Increase
Cross-arms, four-pin	0.579	0.70	21
Arresters, lightning, "F"	3.075	5.85	90
Lamp coloring (quarts)	0.943	2.06	118
Eye bolts, 15-in.	0.0575	0.1608	179
Manila rope, ⅜-in.	0.15	0.22	47
Guy wire, ⅜-in.	0.00768	0.0225	193
Insulators, glass, No. 3	0.0143	0.0237	66
Washers, round, ½-in.	0.00165	0.00392	137
Screws, fetter drive, 4-in.	0.01274	0.0239	87
Machine bolts, 16-in.	0.055	0.0985	78
Guy wire, ¼-in.	0.005	0.0112	124
Wire, triple-braid, W. P. No. 6	0.1254	0.35	179
Machine bolts, 13-in.	0.0473	0.0855	80
Braces, cross-arm	0.1185	0.20	68
Washers, square, 2¼-in.	0.00922	0.0225	144
Mohair lamp cord	0.0122	0.047	285
Gasoline	0.12	0.25	108
Engine oil	0.19	0.2574	35
Poles	.....	.....	33
Average above items	.....	.....	109

The commission granted authority to the Concord company to purchase the Penacook company for $60,000, of which $55,000 may be capitalized. It decided that whether or not a consolidation took place an increase of the Penacook rates to the level of the Concord rates was not unreasonable and should be allowed. The Penacook company has reached its limits so far as water power is concerned and could not take new consumers without running its steam plant.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Franchise Time Limit.—A village resolution giving an electric lighting company certain privileges and providing that it should apply only to a section of a former agreement, which section was limited in time, is itself limited to the same period as the original agreement, according to the Court of Appeals of New York in Weedsport Electric Light Company versus village of Weedsport (115 N. E. 986). The consent by a village to an electric lighting company using its streets, etc., may be lawfully restricted by conditions which do not violate the constitution, statutes or established principles of municipal law.

Regulation of Power Dams.—Law intended as a complete scheme for control of power dams and modifying franchises previously granted, but failing to give some of parties affected right of appeal and review, was unconstitutional for taking private property without compensation and without due process of law and for failing to accord equal protection of laws; the Railway Commission's order under such act requiring defendant to maintain a power dam between maximum level of 6 ft. and minimum level of 5 ft., this being practically an impossibility and less than the usual variation of inland lakes, and the effect of the order being to destroy the value of the plant, but providing a heavy penalty for violation, was invalid, it was held by the Supreme Court of Wisconsin in the State versus Wisconsin-Minnesota Light & Power Company (162 N. W. 433).

Condemnation of Water Power.—The condemnation of certain water rights by a street and interurban railway company, conformably to the local law, cannot be said to be for a private use, and hence wanting in due process of law, on the ground that the contemplated works will produce much more power than will be needed for the railway, and that the company's charter empowers it to sell the surplus power, where the taking, according to the findings of the state courts, was with intent in good faith to carry on the public business authorized by the charter, i.e., to build and operate a railway between points named, and it was further found that it was necessary to generate electric power from the stream in order to operate the railway, that the proceeding was for a public use, and that, in order fully to develop the company's water power for such purpose it was necessary to condemn the rights in question, the Supreme Court held in Hendersonville Light & Power Company versus Saluda-Hendersonville Interurban Railway Company (37 Sup. 440).

Depreciation of Property Due to Tree Cutting by Linemen.—Where linemen in caring for the line went upon plaintiff's property and cut trees therefrom, their acts, though wrongful or negligent, are to be treated as the act of the defendant company, being in furtherance of its business, since it is only when the employee abandons his duty and willfully becomes a wrongdoer that the employer is exempt from all responsibility for the wrongful act, it was held by the Court of Appeals of Maryland (99 A. 991). In action for injuries to realty by cutting trees therefrom in construction of telegraph line, the owner was entitled to show depreciation of the value of the property resulting from the trespass by showing its value before the trespass and its value thereafter.

Negligence of Fellow Employees.—Where a power company did not have any rule that an employee taking an order relative to the cutting of current from a line should report to the person giving the order what had been done, a lineman's mere knowledge of the absence of such a rule did not charge him with assumption of the risk which he encountered in going near a line of the company that his superintendent had ordered cut out, nor would such mere knowledge be inconsistent with a finding that he did not assume the risk, the Supreme Court of Vermont held in Summerskill versus Vermont Power Manufacturing Company (99 A. 1017). A lineman did not therefore assume the risk of injury in approaching a line because he had been near a substation while his superintendent was inside telephoning and waiting to have the current cut off from that line. An employee does not assume extraordinary risks which he understands, and has a right to understand, do not exist. Where the work a power company's lineman was engaged in was that of construction or reconstruction, not of mere operation of the company's system, consisting of the removal of high-tension lines from one side of a highway to the other, the safe-place doctrine applied, and in entering upon the work of attempting to cut out the current from a line other employees of the power company were not fellow employees of the lineman in such sense as to make the fellow-employee doctrine applicable, but stood in the place of the employer in performing a non-delegable duty. Where the fellow-employee doctrine does not apply, the maxim that the principal must respond is applicable. The lineman of a power company who recovered verdict for $7,500 for an electric shock received from a high-tension wire was a high school graduate and had graduated from the department of applied sciences of a university, where he had studied electrical engineering. When injured he was a healthy and intelligent young man, twenty-three years of age, and the shock not only initiated a condition of traumatic neurasthenia, but gave rise to an uncontrollable dread on his part when in the presence of high-tension wires that was likely to impair his capacity in doing electrical work. Verdict held not to be excessive.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Indiana Commission Cases.—The new Public Service Commission of Indiana has issued a résumé of pending cases with a brief classification. The commission, under its first four years, from May 1, 1913, handled many rate cases of electrical utilities and numerous merger cases. The new commission finds that many such cases, however, remain. The summary shows fifty-seven pending cases of different character, which alone probably will require more than a year's time of the commission and its staff. In public utilities the docket shows that there are pending fifteen cases involving physical connection of telephones, thirty-eight telephone rate cases, twenty-one water rate cases, five water service cases, fifty-two electric light and power rate cases, eight electric service cases and five gas rate cases. Eleven applications for authority to issue stocks and bonds were pending on May 1, 1917, besides fourteen applications to surrender franchises and four petitions for purchase and sale of public utilities properties.

Oklahoma Valuation Deferred.—Commissioner Russell of the Corporation Commission of Oklahoma announces that no immediate valuation will be made of the Oklahoma Gas & Electric Company property. A statement by him is in part as follows: "The constitutional duty with which the commission is charged of valuing this plant is in nowise met or changed by the rate concessions or other matters, but in view of the fact that months, or possibly years, will be required to make valuations of all public utilities, the commission feels it can best serve the public interest as a whole by proceeding first with the valuation of the property of such companies as have been unable to make rates satisfactory to their customers. Labor, fuel and machinery are costing from 25 per cent to 100 per cent more now than in the very recent past. The taxes of this company for the coming year will be higher, its assessment having been raised $325,000 above that of the current year, or approximately 13 per cent. The agreement which the company has signed for a 10 per cent reduction in price of electricity (now effective) and an additional 10 per cent, effective in January next, is a very substantial reduction indeed, in the face of the advancing prices everywhere. With these two reductions in effect, the maximum domestic rate will be 7.2 cents per kilowatt-hour (net) and the minimum rate will be 67½ cents per 100 kw.-hr. To encourage the hope that these rates can be cut in two by valuation, or any other process, must lead to inevitable disappointment."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Increase in Stock of Hartford Electric Light Company.—Capital stock of the Hartford (Conn.) Electric Light Company will be increased from $4,500,000 to $6,000,000.

"More than 3000 Uses for Electricity."—The Society for Electrical Development has issued a booklet listing more than 3000 applications of electrical energy in 109 trades and industries. The booklet is one of a series to be issued in connection with the society's "Keep Business Going" campaign.

Lighting Contract in Dayton, Ohio.—W. J. Hagenah of Chicago has been conferring with representatives of the city of Dayton and the Dayton Power & Light Company. He has been employed by the city to make a physical inspection of the lighting company property before execution of a contract for street lighting.

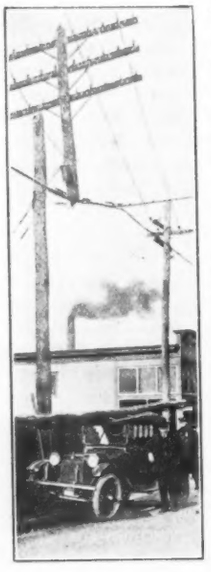
"Business Must Go On."—Under this slogan the Citizens' Electric Company and other utilities of Hot Springs, Ark., tell their community in full-page advertisements in the daily newspapers that never in the history of the world was a nation called upon to perform so gigantic a task. The advertisements show the great demands which will be made upon all classes to participate in world-wide duties, and say that it is the height of folly even to think of hard times in this era of great prosperity.

Plan Permanent Exposition in New York.—The Bronx International Exposition, commemorating the tercentenary of the settlement of the Bronx Borough of New York City, will be opened, it is announced, on May 30, 1918. It will be at the East 177th Street subway station and the Bronx River, New York City, on a tract of twenty-five acres. New effects in the science of illumination will be introduced, and it is expected that W. D'A. Ryan will have charge of the development of this feature. The exposition will be permanent. Over 100 buildings are planned. The general style of architecture will be Spanish colonial.

Water Power in Sweden.—United States Consul General H. W. Harris writes from Stockholm, Sweden, that of the available water power in Sweden, estimated at 6,000,000 hp., about 15 per cent is in use. The number of plants in operation or in process of construction in 1915 was 453. Water power is employed to produce approximately one-half the total annual value of Swedish manufacture. Among the industries using it in 1915 were the following: Timber and pulp, 260,000 hp.; iron, 235,000; electrochemical, 90,000, and textile, 40,000. The total power developed from coal and oil for industrial purposes is about 400,000 hp. Of the installed water and steam power, about 60 per cent becomes electric power.

Franchise Tax for Distribution Outside of City Limits of Wilmington, Del.—On advice of counsel the city of Wilmington, Del., is arranging to collect a franchise tax from the Wilmington & Philadelphia Traction Company for electric light and power generated at the company's local station and sold outside of the city limits. The legal department holds that such electric energy is taxable, inasmuch as the contract for sale is made at the local office and it is immaterial whether the energy generated is disposed of in or out of the city. The company, on the other hand, has disputed the assessment with the contention that the phrase "within the city of Wilmington," as used in the contract between the company and the city, signifies distinctly within the city boundaries.

Unusual Accident.—At Logan, W. Va., an automobile crashed into a telephone pole carrying a heavy load. The car struck the pole with such force that a 20-ft. (6-m.) section was broken out of the pole just above the ground line. This part of the pole fell across the top of the car and remained securely balanced there, as the illustration shows. The upper 10-ft. (3-m.) section of the pole, relieved of its former support, dropped down and alighted squarely upon a messenger wire which was strung above the street at a less height. There the piece of pole remained in an upright position. The photograph was supplied by C. W. De Forest, Union Gas & Electric Company of Cincinnati.



Commissions Should Decide, Governor Whitman Holds.—Governor Whitman of New York State has vetoed the Baxter bill providing that in rate-making for telephone and telegraph corporations the Public Service Commission, Second District, should "take into consideration a reasonable average return upon the value of all the property actually used in the public service within the State." The Governor said: "It seems to me that this is a question which the Legislature should leave to the sound discretion of the Public Service Commission. A corporation is protected by the provisions of the Constitution of the United States, in that its rates cannot be so reduced that it fails to receive a reasonable return on the value of its property, and, as I have said, the question of the rule to be applied should be left to the commission and the courts, not prescribed by law."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

Pittsburgh Section, I. E. S.—On June 8 the Pittsburgh Section of the Illuminating Engineering Society held its June meeting. Robert Garland spoke on the subject of "Daylight Saving."

Dallas Electric Club and Jovian League.—J. G. Barrett, illuminating engineer of the Texas Power & Light Company, addressed the Dallas Electric Club and Jovian League on the subject of illumination on June 4.

Los Angeles Section, A. I. E. E.—"Insulators and Insulator Design," by C. P. Leibold, engineer of the Ohio Brass Company, was the subject of the recent meeting of the Los Angeles Section of the American Institute of Electrical Engineers.

San Francisco Electrical Development and Jovian League.—At the June 6 meeting of this league Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, delivered an address on "The War's Effect on the Electrical Business."

Illinois Contractors' Midsummer Meeting.—The Illinois Electrical Contractors' Association will hold its midsummer meeting at Peoria, June 22 and 23. Col. Robley Stearnes, of New Orleans, president of the National Electrical Contractors' Association, will attend.

The Radio Club of America.—A meeting of the club was held on June 15 in the Engineering Building, Columbia University, New York City. Arthur A. Hebert, general manager of the American Radio Relay League, presented a paper on "Past and Future of the American Radio Amateur."

Pittsburgh Section, A. I. E. E.—The final meeting of the season of the Pittsburgh Section of the American Institute of Electrical Engineers was held June 12. One of the speakers was L. M. Johnston, general manager A. M. Byers Company, who talked on "Selective Conscription and What It Means." Capt. Walter Krueger, Third Infantry, United States Army, spoke on the subject of "Our Task."

Association of Iron and Steel Electrical Engineers.—The regular monthly meeting of this association will be held at Pittsburgh, Pa., to-day, June 16. The paper to be presented at this meeting will be "By-product Coke Ovens in the Steel Industry," by James Farrington. Count Kosloff, lieutenant-colonel in the Russian army, will speak during the dinner on "New Russia." The meetings of the Philadelphia Section have been discontinued until after the annual convention, which will be held in Philadelphia on Sept. 10 to 14, inclusive.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

W. O. Custer, power specialist of the Mansfield Electric & Power Company, has been appointed manager of the Massillon Electric & Gas Company, succeeding T. O. Kennedy.

H. Gordon Gilpin, formerly assistant general manager of the Ohio Electric Railway Company, has been promoted to the position of general manager, with offices at Lima and Springfield, Ohio.

John B. Miller, president of the Southern California Edison Company, Los Angeles, Cal., has been called to Washington as one of the executive committee of five to finance the American Red Cross.

C. A. Bergen, formerly with the Emmanuel properties in Texas, has joined the Commonwealth Light & Power organization as manager of the Stearns Lighting & Power Company at Ludington, Mich.

P. B. Rice has resigned as electrical engineer of the United Gas & Electric Engineering Corporation to accept the position of mechanical and electrical engineer of the International Railway Company at Buffalo.

F. C. Pratt, assistant electrical engineer of the New York office of the Doherty Operating Company, has been appointed manager of the Alliance Gas & Power Company, succeeding W. J. Rose, who resigned to enter the steel business.

J. G. Menut, general manager of the Claremont Power Company, Claremont, N. H., has been made vice-president of the Colonial Power & Light Company, of which the Claremont concern is a branch, and also vice-president and a member of the board of trustees of the Claremont company.

Charles F. Lacombe, who has for the last few years been a consulting engineer at 45 Broadway, New York City, and who was formerly chief engineer of the Department of Water Supply, Gas and Electricity, New York, is now serving in the Second Provisional Regiment, Fifteenth Company, at Plattsburg, N. Y. He has qualified as a captain of engineers and expects within a few days to take up his military duties at Belvoir, Va. Mr. Lacombe's experience in construction and operation of light and power installations, together with his service in the city of New York, should be of value in his new work in governmental service.

W. R. McCann, valuation engineer of the State Public Utilities Commission of Illinois, has been appointed electrical engineer of the Emergency Fleet Corporation of the United States Shipping Board. He reported for duty to General Goethals this week. Mr. McCann prior to his connection with the Illinois commission was supervisor in the former division of erection of the Isthmian Canal Commission, where under the direction of the electrical and mechanical engineer of the commission he designed the electrical transmission system of the Panama Canal. Before going to the Isthmus he was connected with the Commonwealth Edison Company of Chicago.

A. F. Traver, superintendent of the Denver Gas & Electric Light Company, has been appointed manager of the Spokane Gas & Fuel Company.

Ainslie A. Gray, formerly managing editor of the *Electrical Review and Western Electrician,* has formed a partnership with Charles Benjamin, with offices at 608 South Dearborn Street, Chicago, to handle technical and trade advertising. Mr. Gray is well known in technical and publication circles. Besides being a member of various electrical societies and past-president of the Electric Club of Chicago, he is president of the Associated Business Papers, Inc.

T. O. Kennedy, manager of the Massillon Electric & Gas Company, has been appointed superintendent of the Denver Gas Electric Company, succeeding A. F. Traver. Mr. Kennedy was graduated from the University of Missouri in 1907, when he entered the Doherty cadet school at Denver. The following year he went with the Montgomery (Ala.) Light & Water Works Company in the gas works as foreman, from which position he rose to assistant general superintendent. In 1910 he was appointed general superintendent of the Lincoln (Neb.) Gas & Electric Company. During January, 1912, he was sent by the Doherty organization to Forsyth, Mo., as engineer in charge of the Ozark Power & Water Company's development on the White River, where he remained until the fall of 1913, when he was called to New York. The following August found him as general manager of the Massillon property.

William J. Rose has resigned as treasurer and general manager of the Alliance Gas & Power Company to enter business for himself. He has been very prominently connected in all work in the electrical and gas industry and in both national and state associations. He was president of the Ohio Electric Light Association in 1915-1916 and is now chairman of the executive committee of this association. Mr. Rose took a very active interest in the civic development of Alliance as well as being financially interested in a number of its industries. He is at present president of the Rotary Club, director of the Country Club, director of the Merchants and Manufacturers' Club and past-president of the Chamber of Commerce. The employees of the Alliance Gas & Power Company, at a farewell banquet, presented Mr. Rose with a massive table lamp as a token of their appreciation of his work with them. Mr. Rose went to Alliance in 1908 as superintendent and was soon thereafter made manager.

Frank L. Perry, Baltimore, Md., who for a number of years was business manager for the *Western Electrician* of Chicago, has been made a merit member of the Electric Club-Jovian League of Chicago.

N. C. Draper, manager of the Sioux Falls (S. D.) division of the Northern States Power Company, has been elected president of the South Dakota Electrical Association. Mr. Draper became connected with Sioux Falls lighting interests in 1911, when he was appointed manager of the Sioux Falls Light & Power Company, the predecessor of the Northern States Power Company. For a time he was master mechanic of the Central Railway Company of Peoria, Ill., from which he rose to be superintendent of the Peoria & Pekin Terminal Railway Company. He was later vice-president and general manager of the Eastern Wisconsin Railway & Light Company of Fond du Lac, Wis. He was next connected with the Zanesville (Ohio) division of the Columbus, Newark & Zanesville Electric Railway, which supplies Zanesville with lighting, and from there he went to Sioux Falls.

Obituary

Arthur Gunn, who met his death on May 24 by the overturning of his automobile, was one of the founders and

ARTHUR GUNN

first president of the Northwest Electric Light & Power Association. Mr. Gunn was born in Maysville, Ky., March 21, 1866. In 1888 he was graduated from Park College, in Kansas City, Mo., after which he went to the State of Washington, where he started the Kelso *Courier.* From 1892 to 1894 he was engaged in banking in Wenatchee and in 1896 organized in that place what was known as the Pioneer Ditch Company. About twelve years ago he formed the Wenatchee Electric Company, which was later incorporated as the Wenatchee Valley Gas & Electric Company, of which he was president at the time of his death. Mr. Gunn took more than usual interest in civic affairs and was to be found on the governing boards of most of the local civic institutions.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

WAR DEMAND OF GOVERNMENT WILL UNDOUBTEDLY BE LARGE

Military and Naval Appropriation Bill Before House of Representatives Includes an Item of $5,900,000 for Searchlamps

Government orders for electrical goods for war purposes will undoubtedly reach a very large total aside from the demand otherwise created by the war. While no figures are available showing how much the government intends to expend on electrical equipment, the figure of $5,900,000 for searchlamps, included in the House military and naval expense bill, is significant.

In view of the available capacity for searchlamp production this figure is considerable. It is not known whether the appropriation includes the necessary auxiliary electrical equipment. Field lamps of the nature used abroad and also used by American forces in the Mexican punitive expedition are supplied with energy from gasoline-driven generators.

SCARCITY OF STEEL MAY AFFECT 1918 FAN DESIGN

Cast-Iron Product Seems Likely to Supersede the Pressed Steel Which Is Now Turned Out by Most Manufacturers

Scarcity of raw materials is liable to have a much more than temporary effect in the electrical market. Particular reference is had at this time to electric fans. Most manufacturers are turning out at present a pressed-steel fan. There has been great difficulty in getting steel this year, but the anticipated action of the government in commandeering a very substantial part, perhaps 50 per cent, of the steel output of the country may seriously embarrass manufacturers should they continue the manufacture of the same types.

It seems quite likely, therefore, that the 1918 design of electric fans will show a predominating use of cast iron. Some manufacturers are now using cast iron, and there is no doubt that this number will be materially increased before another season rolls by.

The use of cast iron in place of pressed steel will, of course, reduce the cost of manufacture somewhat and will consequently help materially to prevent the price of fans from advancing very much.

DEMAND FOR PASSENGER ELECTRICS MAINTAINED

Business Stimulated in Spite of Increase in Price—High Cost of Labor and Materials Will Force Another Advance Soon

Contrary to the general rapid decline in the gasoline pleasure-car business, the demand for electric pleasure cars has kept up remarkably well, and while in comparison with last year there is probably no appreciable increase, it must be remembered that during the first quarter of the current year the demand for these cars was decidedly below that of last year. Since then, however, business has picked up, and during last month it was particularly good, although some of the more prominent manufacturers had put into effect a price advance about the first of May.

Distributers and manufacturers of electric vehicles are optimistic over the existing situation. Higher prices for gasoline cars are foreseen, and this is expected to act in favor of the electric. Furthermore, there is a fear among gasoline-car men that the government may follow the lead of England and France in commandeering gasoline vehicles for military purposes. In this event, of course, the sale of electrics would be greatly increased for local use.

Already some of the cars have been advanced around $200, and within a few days another advance, probably in the neighborhood of $100, is expected. Manufacturers have made every effort to keep the price down, feeling that a popular-priced car would appeal more to the general public. However, it has not been possible to withhold an advance any longer without sacrificing quality. Labor and materials have advanced to such an extent that a price increase became necessary.

JOBBERS' INVESTMENT IN STOCK MORE THAN DOUBLED

Average Advance in Supplies, Volume for Volume, Around 50 per Cent in the East, While Stocks Increase in Amount 40 per Cent

Not only have jobbers been required to carry a stock of late greatly in excess of normal—in fact, an excess on the average of 40 per cent in the East was shown in the ELECTRICAL WORLD for last week—but they have been required to carry this stock when prices have been rising

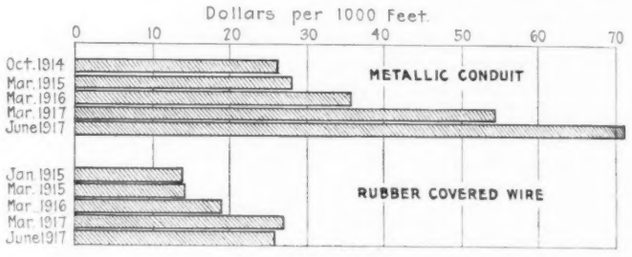


CHART SHOWING RAPID ADVANCE IN COST OF TWO MAJOR ITEMS IN JOBBERS' STOCKS

(Conduit has advanced 171 per cent in thirty-two months; wire, though lower now, did increase 93 per cent)

until they are considerably greater than they were two years ago. A further canvass of Eastern jobbers shows, as with stock, a great discrepancy in the figures. On the average, however, electrical supplies have advanced in the last two years in the neighborhood of 50 per cent. In other words, a jobber with the same volume of stock now that he had two years ago would probably find that he had 50 per cent more capital tied up in stock than he did in the late spring of 1915.

Since, however, the average condition revealed was a surplus stock of 40 per cent, then it becomes evident that the jobbers' additional investment in stock on which there is no return is not 50 per cent on the average, but 110 per cent.

The figures, of course, are based entirely on the results of the canvass of the Eastern supply men, but, as was pointed out in the ELECTRICAL WORLD last week, it is doubtful if conditions, except in isolated cases, are any better in any section of the country. In fact, on the Pacific Coast there are good reasons to believe that the jobbers' additional investment in stock is much more than 110 per cent because they have had to stock up more heavily than houses nearer the source of supply.

Prices of electrical supplies began to advance along in 1915 and since that time have continued to show increases. Prices for two of the major items, rubber-covered wire and

metallic conduit, covering the period of price increase up to the present, are shown graphically in the accompanying diagram. All supplies, of course, have not advanced so rapidly or as much as have these two, but with the exception perhaps of incandescent lamps there is hardly a line of general electrical supplies that has not increased in price once or more in the past two years.

Naturally this has had its effect on the jobbing trade. It has meant that a considerably greater volume of business has been done on credit. It has also caused jobbers generally to be much more cautious than formerly. Practically to double the investment in stock when it is well understood that 50 per cent is represented entirely by an increased value that will vanish as conditions approach normal has placed the trade in a peculiar position.

NEED OF STANDARDIZATION IN FOREIGN TRADE COMPETITION

English Manufacturers of Engineering Products Foresee the Necessity for Standard Specifications

To-day the foreign trade of the world belongs to that nation that can supply and will supply the goods. After the war a different condition will exist. Then there will be more manufacturing facilities available. Then there will be competition to obtain foreign trade to keep the factories at home running. So great will be the competition that everything will be done to lower the cost of production.

Quantity production will be one way to lower cost, and perhaps the greatest. This demands two things: (1) quantity sales, and (2) standardization. This is true whether it be for an individual manufacturer or for a group of manufacturers. It must therefore be easy to sell the goods. The proposition must be cut and dried so that time will not be lost in specialty sales. In the foreign markets, therefore, standardization of goods will be a very important factor. It will be necessary, furthermore, for the manufacturers of every nation to stick together. When the attention that England and Germany and France are giving to the after-war trade in foreign markets is noticed and studied, it will be seen that when the war is over it will not be the individual manufacturer's motor or switch, etc., that is sold, but an English motor, a German transformer, etc.

The Germans have their unions for promoting sales. England has caught the spirit, and through the British Engineering Standards Committee has standardized on British equipment, and realization of this as a factor in the foreign market has not been lost. Believing that urgent steps are needed to assist British engineering manufacturers in competing successfully in foreign markets, this committee has made the following recommendations:

"(a) That the specifications of the British Engineering Standards Committee, or at least the more important of them, should be at once translated into French, Spanish and Russian, with metrical equivalents for the British measurements and formulas.

"(b) That local committees of engineers and traders in close touch with the main committee in London should be formed at about twelve important trading centers—for example, in the Argentine, Brazil, Canada, Chile, China, India, Peru, Portugal, Russia, South Africa, Spain, Uruguay.

"(c) That the price of all our publications, whether in English or the other languages, should be largely reduced, viz., to about 1 shilling (24 cents) a copy or its equivalent in foreign moneys.

"(d) That the local committee should have as chairman the British consul or other government representative."

The British government has decided to give its assistance in carrying these investigations into effect. The British Foreign Office and the Board of Trade have decided to support the new venture through their officials, and the British treasury has given valuable financial assistance.

Already a start has been made on these recommendations by British manufacturers. The British Electrical and Allied Manufacturers' Association, beginning with the March issue, is translating *Beama*, the official monthly publication of the organization, into Russian and Spanish and distributing copies in Russia and in Spanish-speaking countries. This is in line with recommendation (a).

Very little so far has been done in the United States to prepare for the competition in the world's foreign trade that is to follow the war. Little strong co-operative effort is being made to place American goods as such on the markets of the world.

COPPER AND INSULATED WIRE MARKET CONDITIONS

Low-Priced Stocks in Hands of Jobbers Pretty Well Disposed of, so that Present Sales Are Based on Current Market Prices

BY M. A. OBERLANDER

Supply Sales Manager Western Electric Company, Inc.

The copper market seems to be more active, bar copper being quoted at 32 cents and 32½ cents a pound. With the demand keeping up, there is every indication that we shall have a stable market, though of course at times there may be some slight fluctuations. Taking all conditions into consideration, it would appear that prices on copper will remain firm for some time to come.

From all indications the low-priced stocks of insulated wire in the hands of the jobbers have been pretty well disposed of, and it would seem that most of the sales now made by jobbers are based on wire bought at approximately present market prices.

It appears from investigations that have been made of the prices now quoted to consumers that they are more in line than those quoted some six months ago, when the cost of the material in the hands of the jobbers varied considerably. Taking into consideration the likelihood of the continued demand for insulated wires of the various grades, it would seem foolhardy for any one to sacrifice any stock that he may have on hand which was purchased at a lower price than the present market. Rubber-covered wire is being quoted in large quantities on the 38-cent base.

GENERAL CONDITIONS IN METALS MARKET

Lead Has Advanced, While Tin Has Receded Somewhat—Copper Quotations Higher on Future Deliveries

Generally speaking, there was little activity in the several metals markets as the week opened. Lead is higher than during the previous week, while tin is somewhat lower. Copper is firm, with slightly higher prices prevailing for future deliveries.

Reports from Washington have indicated a desire on the part of the government to purchase copper on the basis of cost plus a reasonable profit.

Nominal quotations were made on Monday for electrolytic copper as follows: June, 32.75 cents; July, 31.75 cents; third quarter, 31 cents, and fourth quarter, 29.50 cents.

NEW YORK METAL MARKET PRICES

	June 4 Selling Prices Bid	Asked	June 11 Selling Prices Bid	Asked
Copper:	£ s d		£ s d	
London, standard spot	130 0 0		130 0 0	
Prime Lake	31.00 to 32.00†		31.00 to 32.00†	
Electrolytic	32.50 to 33.00†		32.50 to 33.00†	
Casting	30.50 to 31.00†		30.00 to 31.00/	
Copper wire base	37.00 to 38.00/		37.00 to 38.00†	
Lead	10.00		11.00	
Nickel	50.00		50.00	
Sheet zinc, f.o.b. smelter	19.00		19.00	
Spelter, spot	9.55 to 9.67½		9.55 to 9.67½	
Tin, Straits	61.50†		60.75†	
Aluminum, 98 to 99 per cent	56.00 to 58.00†		56.00 to 58.00	
OLD METALS				
Heavy copper and wire	28.00 to 28.50		28.00 to 28.50	
Brass, heavy	17.50 to 18.00		17.50 to 18.00	
Brass, light	14.25 to 14.75		14.50 to 14.75	
Lead, heavy	9.25 to 9.75		10.00 to 10.25	
Zinc, scrap	7.25 to 7.50		7.25 to 7.50	

†Nominal.

Current Prices of Electrical Supplies

NEW YORK AND CHICAGO QUOTATIONS

The prices quoted are those prevailing in standard package or specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists to contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the source of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers.

The variation in prices may be due to the difference in grade of products made by different manufacturers, to local conditions or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B. & S. Size		List, per 1000 Ft.
No. 14	solid	$61.00
No. 12	solid	71.00
No. 10	solid	90.00
No. 8	solid	106.00
No. 6	solid	145.00
No. 10	stranded	95.00
No. 8	stranded	115.00
No. 6	stranded	160.00
No. 4	stranded	205.00
No. 2	stranded	266.00
No. 1	stranded	315.00

Twin-Conductor

No. 14	solid	104.00
No. 12	solid	135.00
No. 10	solid	185.00
No. 8	stranded	235.00
No. 6	stranded	370.00
No. 4	stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 solid:	
Less than coil	+10% to $54.90 Net
Coil to 1000 ft.	3% to 48.80 Net
No. 12 solid:	
Less than coil	+10% to 63.90 Net
Coil to 1000 ft.	3% to 56.80 Net

Twin-Conductor

No. 14 solid:	
Less than coil	+10% to $78.00 Net
Coil to 1000 ft.	3% to 75.00 Net
No. 12 solid:	
Less than coil	+10% to 121.00 Net
Coil to 1000 ft.	3% to 108.00 Net

DISCOUNT—CHICAGO

Single-Conductor

No. 14 solid:	
Less than coil	+10%
Coil to 1000 ft.	10%
No. 12 solid:	
Less than coil	+10%
Coil to 1000 ft.	10%

Twin-Conductor

No. 14 solid:	
Less than coil	+10%
Coil to 1000 ft.	10%
No. 12 solid:	
Less than coil	+10%
Coil to 1000 ft.	10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20% to 12%
1/5 to std. pkg.	10% to 20%
Std. pkg.	24% to 34%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+10% to 12%
1/5 to std. pkg.	10% to 12%
Std. pkg.	34% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.35	$0.35
12 to 50	.30	.30
50 to barrel	.28	.28 to .29
Barrel lots	.24	25

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.35	$0.35
12 to 30	.30	.30
50 to barrel	.255 to .28	.285 to .29
Barrel lots	.24 to .24¾	.25 to .25¾

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
5/16	250	$5.00
¾	250	7.50
½	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25-50	35.00
2	25-50	45.00
2½	25-50	52.00

DISCOUNT—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	.....	.....
⅜-in. double strip	.....	.....
½-in. single strip	Net to 10%	7% to 20%
½-in double strip	Net to 5%	4% to 15%

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$71.25 to $75.00	$60.00 to $63.75
⅜-in. double strip	75.00 to 78.75	67.50 to 71.25
½-in. single strip	95.00 to 100.00	80.00 to 85.00
½-in. double strip	100.00 to 105.00	90.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, in.	List, per Foot	Size., in	List, per Foot
7/32	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
⅝	.15	2	.55
¾	.18	2¼	.65

DISCOUNT—NEW YORK

Less Than $15 List	$15 to $60 List	$60 to $150 List
Net to 33⅓%	45% to 50%	53% to 55%

NET PER 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.	$36.67 to $55.00	$27.50	$23.10 to $24.75
¼-in.	40.00 to 60.00	30.00	25.20 to 27.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, in.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	27½
2	.37
2½	.58½
3	.76½

	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.60
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ In. to ½ In.	¾ In. to 3 In.
Less than 2500 lb.	6% to 8%	8% to 10%
2500 to 5000 lb.	9% to 11%	11% to 13%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ In. to ½ In.	¾ In. to 3 In.
Less than 2500 lb.	3.8% to 5.8%	5.8% to 7.8%
2500 to 5000 lb.	6.8% to 8.8%	8.8% to 10.8%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

Net	$3.15 to $3.50

CHICAGO

Net	$3.10 to $3.85

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	28%
1/5 to std. pkg.	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	28%
1/5 to std. pkg.	38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.75 to $6.30
1/5 to std. pkg.	4.50 to 5.25

Standard package, 500. List, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, $0.07.

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std Pkg.	List, Each
10 to 40-watt—B	100	$0.27
60-watt—B	100	.36
100-watt—B	24	.65
75-watt—C	50	.65
100-watt—C	24	1.00
200-watt—C	24	2.00
300-watt—C	24	3.00
Round bulbs, 3⅛ in., frosted:		
15-watt—G 25	50	.50
25-watt—G 25	50	.50
40-watt—G 25	50	.50
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.72
Round bulbs, 4⅝ in., frosted:		
100-watt—G 35	24	1.05

105 to 125 Volts

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net list
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00 to $35.17
Coil to 1000 ft.	21.00 to 26.73

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$37.20 to $38.16
Coil to 1000 ft.	27.90 to 28.62

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100	$18.00 to $29.00

CHICAGO

Net per 100	$12.50 to $28.35

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, A.X. 1½, 4 S.	30.00
103—C.A., 9, 4 R., B 1½	25.00
106—F.A., 7, C.S. 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	List to 33%	List to 27%
$10.00 to $50.00 list	42%	18% to 37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$14.00 to $20.00
1/5 to std. pkg.	13.00 to 15.80

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$14.00 to $18.00
1/5 to std. pkg.	13.00

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	5½ N.C.—Solid Std. Pkg. 3500	Nail-it—N.C. Std. Pkg. 4000
Less than 1/5 std. pkg.	$10.50 to $24.30	$21.10
1/5 to std. pkg.	9.75 to 12.15	28.00

CHICAGO

Per 1000 Net	5½ N.C.—Solid Std. Pkg. 3500	Nail-it—N.C. Std. Pkg. 4000
Less than 1/5 std. pkg.	$8.40 to $18.00	$20.75 to $28.00
1/5 to std. pkg.	7.80 to 9.00	16.30 to 21.50

SOCKETS AND RECEPTACLES

	Std. Pk.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15% to 20%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

Perkins or Trumbull Type A:	List
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30 amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Perkins Type B or Trumbull Type C:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

Less than $10 list	
$10 to $25 list	11% to 16%
$25 to $50 list	14% to 24%

DISCOUNT—CHICAGO

Less than $10 list	+ 5% to 5%
$10 to $25 list	11% to 16%
$25 to $50 list	14% to 24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp., three-point	100	.56
10-amp., three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to Net
1/5 to std. pkg.	Net list to 15%
Std. pkg.	30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar	List, Each
No. 155	$0.34
No. 160	0.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 23%	Net to 18%
$2.00 to $10.00 list	23% to 50%	18% to 40%
$10.00 to $50.00 list	23% to 60%	18% to 52%

DISCOUNT—CHICAGO

	Black.	Galvanized.
Less than $2.00 list	....	....
$2.00 to $10.00 list	25% to 50%	15% to 40%
$10.00 to $50.00 list	35% to 64%	25% to 52%

TOASTERS, UPRIGHT

NEW YORK

Net price	$3.15 to $3.50

CHICAGO

Net price	$2.80 to $3.50

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.52 to $0.62
No. 18, full spools	0.48 to 0.53

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.65 to $0.6885
No. 18, full spools	0.5285 to 0.55

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00-18.00	12.00-14.50	11.50-12.50
12	21.06-27.05	18.96-22.85	18.01-20.95
10	29.60-39.27	26.64-33.66	24.68-25.31
8	42.40-51.44	38.16-48.42	33.51-36.25
6	72.19-89.57	64.98-76.80	56.63-61.73

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00	$16.00	$14.00
12	27.05-29.89	22.05-25.62	20.95-23.48
10	38.20-42.28	32.00-36.64	29.60-33.22
8	46.54-60.13	42.35-51.54	37.70-42.95
6	72.70-82.20	66.65-75.35	59.40-68.50

WIRE, WEATHER-PROOF

Solid-Conductor, Triple-Braid, Sizes 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$40.25 to $45.00
25 to 50 lb.	39.25 to 42.00
50 to 100 lb.	38.00 to 38.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$44.85 to $45.35
25 to 50 lb.	43.85 to 44.35
50 to 100 lb.	42.85 to 43.35

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Hot Plates

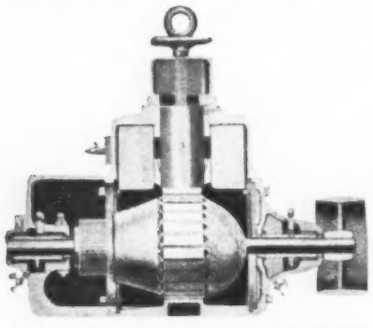
The hot plate shown in the accompanying illustration is a product of the Standard Electric Stove Company of Toledo, Ohio. The resistor ribbon is cut to give exactly the number of watts desired by measuring each element with

PORTABLE HOT PLATE

a wattmeter. The nichrome resistance ribbon which is used in the heating element is coiled and laid into a clay product, which has high heat conductivity and yet is a non-conductor of electricity. The clay is baked at a temperature of 1500 deg. to secure a glass finish. To prevent radiation of heat below the element, a rock mineral-wool pad is held in place by a rimmed metal bowl and porcelain terminal block, to which leads are attached. There are no channels or recesses to accumulate dirt. These heaters are made for 110 volts unless otherwise specified. The total demand is 1000 watts.

Multi-Speed Motor

The improved type of multi-speed motor shown in the accompanying illustration is manufactured by the Stow Manufacturing Company, Binghamton, N. Y. It is said to have a speed range similar to that of direct-current motors. Maximum efficiency is secured over the speed range provided without the expense and complication of auxiliary machines, controllers or rheostats, the speed being varied by turning a hand-

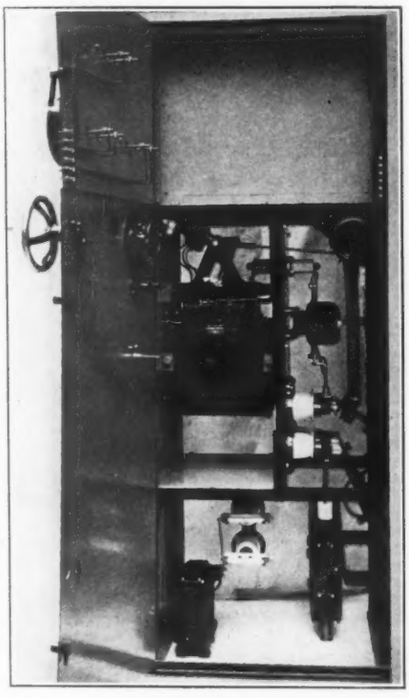


MOTOR WITH WIDE RANGE OF SPEED

wheel which changes the reluctance of the field magnetic circuit. The motor is furnished in two types—bipolar and four-pole. Both are iron-clad and particularly adapted to steel-mill service and for driving heavy machinery as well as printing presses, pumps, etc. The pole pieces and plungers used to vary the magnetic reluctance are designed so that as the volume of effective magnetism is diminished by the outward movement of the plunger the remaining magnetic flux is forced toward the direction of the pole tips, thus furnishing a magnetic field which, it is said, will insure sparkless commutation.

Switching Compartment Unit

Compartment units primarily intended for substation use, any number of which can be assembled together to form a complete switchboard, have been



SWITCHING COMPARTMENT UNITS THAT INTERLOCK

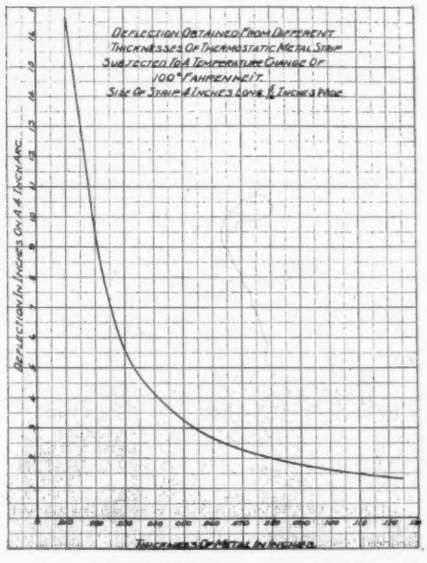
developed by Ferranti Limited, Hollinwood, Lancashire, England. These units are provided with a mechanical interlock which, it is claimed, insures that (a) access cannot be obtained to high-tension apparatus until it has been de-energized, (b) knife switches cannot be opened until the oil switch has been opened, (c) oil switch cannot be closed unless the knife switches are completely open or completely closed, (d) the ground switch, when fitted, cannot be closed until the isolating switches are completely open, and (e) the lower door cannot be opened until the ground switch is closed.

All of the apparatus inside of the unit is accessible from the front, so the units can be installed close to a wall or in a recess. A wide range of equipment is provided to suit the needs of the user.

The unit is built of strong steel plates and angle iron and is divided into compartments by horizontal and vertical division plates. The front plates form two hinged doors, the upper one serving to carry any instruments required. When the door is opened the connections to the instruments are completely exposed. A steel plate shields these connections from adjacent high-tension apparatus. The lower door carries the operating apparatus for the switches, and also provides additional space for instruments, relays, etc.

Thermostatic Metal

The General Electric Company of Schenectady, N. Y., has perfected a product to be known as "thermostatic metal," which bends or regains its original straightness in accordance with well-defined laws as the temperature rises or falls. As a result of this responsiveness to temperature change and the mechanical force developed, this metal is used to actuate various mechanisms which tend to neutralize either the temperature change or its effect upon devices.


Deflection Obtained From Different Thicknesses Of Thermostatic Metal Strip Subjected To A Temperature Change Of 100° Fahrenheit
Size Of Strips 4 Inches Long By 1/2 Inches Wide
Deflection In Inches On A 4 Inch Arc
Thickness Of Metal In Inches

CURVE OF DEFLECTION PER DEGREE OF TEMPERATURE CHANGE

This metal consists of two strong non-corrosive metals possessing widely different coefficients of expansion, the widest difference possible, it is said, for any known stable combination of metals. These two metals are firmly

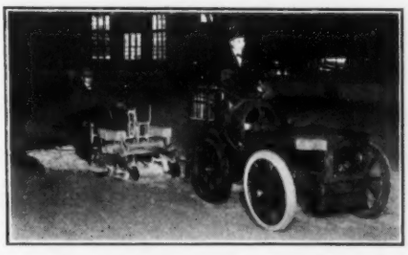
attached to each other throughout their entire length so that there is absolutely no slippage of one metal on the other. The metal can be cut, stamped or pressed into practically any desired shape, and when annealed will have all its original inherent qualities. Moreover, it will not deteriorate nor take permanent "set" under applications of heat or force within definite practical limits. The metal is manufactured in various standard thicknesses ranging from 0.25 in. to 0.015 in. (6.4 mm. to 0.39 mm.), maximum width of 4 in. (10.16 cm.) and maximum length of 36 in. (0.91 m.).

As an indicator this metal is remarkable in that it can be used for temperatures as high as 500 deg. Fahr. (260 deg. C.). The deflection per degree of temperature change, besides being quite considerable as shown in the accompanying curve, is a constant for any definite piece of the metal. Since a definite and considerable opposing force is necessary to cause the metal to take permanent set, the metal can be depended upon when used in devices where extreme accuracy is required, it is claimed.

If the curving of this thermostatic metal on heating or cooling is opposed, the metal will produce a mechanical force, which is limited only by the force required to produce permanent set.

Ice Scraper

The electrically driven ice scraper, shown herewith, which is intended for rinks, has been developed by Dudley H. Scott of Cleveland, Ohio. The scraper was made by mounting a 10-hp. Lincoln slip-ring induction motor on a small automobile chassis, connection being made to the transmission shaft of the chassis by a chain. The reason for running the outfit with this type of motor was to secure a very slow and variable speed. The tractor draws a trailer which carries a planing blade adjustable as to the depth of the cut. Power for the planer is secured through the cable suspended from the center of the roof. The cable is attached at both ends, so it will not twist when the tractor is driven around the rink. The cable drags on the ice, but with no interference with the management of the planer, except in the



ELECTRICALLY DRIVEN ICE SCRAPER

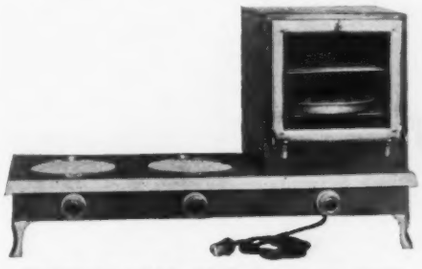
last two or three trips up and down the center of the rink. An Allen-Bradley controller is used to vary the speed of the motor. By use of this particular type of controller a very fine graduation of speed may be obtained.

Waste Heat Gage

The Precision Instrument Company of Detroit, Mich., has developed a combination of two gages in one case that can be used with natural-draft boilers, boilers utilizing the gases from a heating furnace, economizers, or in connection with any waste-heat service. The gages are inclosed in substantial dust-proof black-enamel cases. A door makes the interior of the gage accessible. The dials have a dull aluminum finish, with distinct black numbers. Provisions are made to permit checking the U-gage and adjusting the setting to zero. Recording gages in the same type of case and having the same range can also be supplied.

Kitchenette Range

The Allmur Manufacturing Company of Marion, Ind., has developed the kitchenette range shown in the accompanying illustration. The oven is 12 in. (30.48 cm.) long by 12 in. (30.48 cm.) wide by 16 in. (40.6 cm.) high, and is equipped with a glass door. The heating units are of the patented type made by this company, that can be easily removed, being held in place by wing units. The elements are wound



HEATING UNITS REMOVABLE ON THIS RANGE

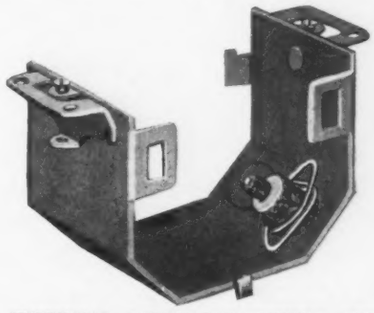
for a demand of 600 watts each. The range is 33 in. (83.8 cm.) long, and 20 in. (50.8 cm.) high.

Wood Preserver

Prior to the war, practically all of the so-called carbolineum or anthracene wood-preserving oils were imported from Germany. Since imports have been cut off, the Kettle River Company, Minneapolis, Minn., has placed on the market a product known as K-R wood preserver, which, it is said, is superior to the formerly imported German product. This wood preserver is a straight distillate of bituminous coal tar, free from any adulteration. The specifications for quality and purity are very stringent. When analyzed by the methods described by the United States Signal Service of the United States Navy, the oil has passed the following specifications before being placed in steel tanks, from which it is drawn into steel drums for the trade: Specific gravity at 39 deg. C., 1.11 to 1.13; flashing point, above 120 deg. C.; burning point, above 165 deg. C.; distillate below 235 deg. C., not exceeding 2 per cent.; distillate between 235 deg. C. and 300 deg. C., not exceeding 10 per cent; pure liquid coal-tar oil residue at and above 300 deg. C., over 90 per cent; tar acids, less than 2 per cent; sulphonation residue, less than 0.25 cc. (or 0.25 per cent); constituents insoluble in benzol, less than 0.25 per cent; condition at 38 deg. C., liquid; ash left on ignition, not exceeding 1 per cent.

Switch Box

Sectional screwless switch boxes similar to the one shown herewith that may be fastened together with screws

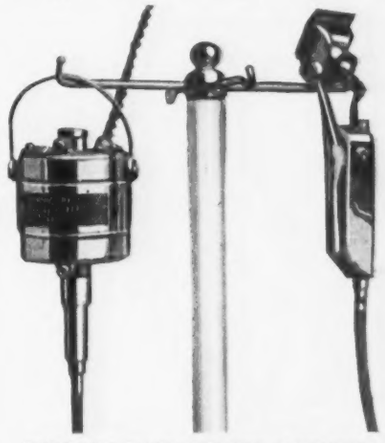


SECTIONAL SCREWLESS SWITCH BOX

are made by the A. B. Wilson Company, Leader-News Building, Cleveland, Ohio. The dimensions of these boxes are 2.25 in. (5.72 cm.) deep by 2 in. (5.08 cm.) wide by 3 in. (7.6 cm.) long, leaving plenty of room inside the box. The ears of this type of box are reversible, so it may be made to fit any wall device.

Electric Hair Cutter

An electric hair cutter designed to perform its function in a short time and with small discomfort to customers has been placed on the market by the Moore Electric Corporation of Chicago. A Racine motor, rated at 0.05 hp. and operating on 110-130 volts, alternating or direct current, drives a worm in the hair cutter by means of a flexible shaft. A crank attached to this gear operates the clipper with a sliding motion. With



ELECTRIC HAIR-CUTTING MACHINE

this device hair can be cut easily in five minutes and records of three-minute hair cuts have been made. A vibrator is also made to operate from the motor and can be interchanged with the hair cutter in a few seconds.

Trade Notes

HICKEY & SCHNEIDER have taken larger offices in the same building as before, 61 Broadway, New York City.

ROBERT H. PATCHEN has resigned as secretary of the National Foreign Trade Council to become affiliated with W. R. Grace & Company. He is succeeded by O. K. Davis.

THE WESTINGHOUSE LAMP COMPANY announces the removal of its New York district sales office from 200 Fifth Avenue to rooms 2021-2023, 165 Broadway, New York City.

THE SMITH PERRY ELECTRIC COMPANY, Dallas, Tex., will in the future act as distributer throughout Texas and Oklahoma for electric ranges and heating devices manufactured by the Globe Stove & Range Company of Kokomo, Ind.

D. H. THOMSON has been elected president and treasurer of the Terry Steam Turbine Company of Hartford, Conn., filling the vacancy caused by the death of James Terry. N. L. Snow, sales manager of the company, has been elected vice-president.

ERNEST F. LEARNED, formerly with the engineering department of Stone & Webster, has joined the staff of the Day Baker Motor Truck Company, Boston, Mass., as head of the industrial electric truck department. He will handle the C. W. Hunt Company's electric trucks and power plant coal-handling equipment.

THE ROYAL BANK OF CANADA, with offices at William and Cedar Streets, New York City, announces that it has opened four branches in Venezuela, at Caracas, Maracaibo, Ciudad Bolivar and Puerto Cabello. These are in addition to fifty-one branches in the West Indies, South and Central America. The bank is prepared to transact a general banking business at these points.

ROBERT ABBOTT, who for the last eight years has been connected with the sales organization of the Bryant Electric Company, and has managed its New York office since it was opened in 1913, has volunteered for service in the Roosevelt base hospital unit, and sailed for France last week. No announcement has been made by the company with reference to his successor in the New York office.

C. S. BUTLER, who has been associated with the Hess-Bright Manufacturing Company for about seven years, has been appointed sales manager of the Carlson-Wenstrom Company, Richmond Street and Erie Avenue, Philadelphia, Pa. It is the intention of the Carlson-Wenstrom Company to introduce and manufacture a new design for high-grade double-row ball bearings, as well as to market a complete line of thrust ball bearings.

C. W. CHESTNUT, who for the past two and a half years has been sales manager of the Western Electric Company at Omaha, Neb., was recently transferred to the Seattle offices of the company. He will hold the same position in Seattle and will have supervision of both the Portland and Seattle branches. The position of sales manager in Seattle heretofore has been held by J. I. Colwell in connection with his duties as manager. Mr. Colwell will continue as manager of the Seattle office.

THE TRUMP MANUFACTURING COMPANY, Springfield, Ohio, manufacturer of water-power machinery, states that the receivership under which it has been operated for the past seven years has been lifted and the company is doing business as a going concern. The engineering department and the management remain unchanged. The company reports having on its books a larger volume of business than ever before in its history and that the prospects for the future are more than encouraging.

THE SANGAMO ELECTRIC COMPANY of Springfield, Ill., announces the opening of a San Francisco office at 37 Stevenson Street, in charge of L. A. Nott, district manager. This office will represent the Sangamo company in northern California and that part of southern California not handled by the Sangamo company's Los Angeles office. Mr. Nott was for many years with the Standard Underground Cable Company, and has been latterly with the K. P. F. Electrical Company, which association he will continue. The Sangamo company will now carry a complete stock of meters, repair parts, etc., in San Francisco.

AINSLIE A. GRAY and CHARLES L. BENJAMIN have formed a partnership under the name of Gray & Benjamin, with offices in the Transportation Building, 608 South Dearborn Street, Chicago, to engage in technical and trade advertising. The firm proposes to act as advertising counsel to manufacturers of electrical, mechanical, chemical and kindred products, besides analyzing and reporting upon processes of manufacture and distribution and supervising the preparation of advertising copy for technical and trade papers, booklets, house organs, catalogs and incidental advertising propaganda. Mr. Gray was formerly managing editor of the *Electrical Review and Western Electrician*, and Mr. Benjamin prior to the last two years was advertising manager of the Cutler-Hammer Company.

New Incorporations

THE COURTNEY (N. D.) ELECTRIC POWER PLANT COMPANY has been incorporated by Joseph Nelson, O. T. Fosholdt and A. G. Bjerken of Courtney.

THE HARDINSBURG (KY.) ELECTRIC LIGHT COMPANY has been chartered with a capital stock of $3,000 by Alfred Taylor, R. R. Compton and P. Compton.

THE SEWICKLEY (PA.) TOWNSHIP LIGHT COMPANY has been chartered with a capital stock of $5,000 to operate in Sewickley Township. E. S. Haymond of Wilkinsburg, Pa., is interested in the company.

THE SOUTH HEIGHTS (PA.) ELECTRIC COMPANY has been incorporated with a capital stock of $5,000 to operate in South Heights. E. S. Haymond of Wilkinsburg, Pa., is interested in the company.

THE ELECTRIC ENGINEERING & MANUFACTURING COMPANY of Chicago, Ill., has been incorporated with a capital stock of $1,000 by Charles S. Babcock, Walter F. Olds and William F. Kennedy.

THE SEYMOUR (WIS.) ELECTRIC COMPANY has been incorporated by W. E. Daniels, E. P. Daniels and S. D. Newell. The company is capitalized at $10,000 and proposes to furnish electrical service in Seymour.

THE WOODLAWN (PA.) ELECTRIC COMPANY has been granted a charter with a capital stock of $5,000 to furnish electrical service in Woodlawn. E. S. Haymond of Wilkinsburg, Pa., is interested in the company.

THE ILLUMINATING COMPANY of Greenspring, Ohio, has been chartered with a capital stock of $15,000 to supply electricity in Greenspring. The incorporators are: H. C. Gammeter, B. A. Young, A. E. Neikirk, J. C. Kinney and R. D. Reynolds.

THE STAMFORD (CONN.) ELECTRIC & MANUFACTURING COMPANY has been incorporated by Edward Heitman, William M. Foord and Matthew H. Kenealy. The company is capitalized at $150,000 and proposes to manufacture electrical and other machinery.

THE KINGSPORT UTILITIES of Bristol, Va., has filed articles of incorporation with a capital stock of $1,000,000 to construct and operate an electric-light and power plant. The officers are Sherwood E. Hall, president, and Edward C. Bailly, secretary, both of White Plains, N. Y.

THE POLITOWSKI MAGNETIC ENGINE COMPANY of Dover, Del., has been incorporated under the laws of the State of Delaware with a capital stock of $1,000,000 to manufacture magnetic, electrical and other machinery. The incorporators are: A. N. Jarvis and Samuel MacKechan Dayne, both of Chicago, Ill.

THE POWERLIGHT COMPANY of Dover, Del., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $500,000 to manufacture lamps and illuminating specialties. The incorporators are: Samuel B. Howard, Arthur W. Britton and Louis H. Gunther, all of New York, N. Y.

THE HARDYSTON ELECTRIC COMPANY of Newton, N. J., has been incorporated by Thomas W. Waters of Haddon Heights, N. J.; Edgar S. Waters of National Park, N. J.; John L. Atwell of Brooklyn, N. Y., and Charles S. Rinds of Upper Montclair, N. J. The company is capitalized at $100,000 and proposes to furnish electrical service in this vicinity.

THE ELECTRONITE MANUFACTURING COMPANY of Salt Lake City, Utah, has been chartered with a capital stock of $1,000,000 to manufacture and deal in electrical fixtures, including electric robes, blankets, slippers and pads. The officers of the company are: L. C. Hornschurch, president; H. L. Bliss, vice-president, and Chester A. Elliott, secretary and treasurer.

Trade Publications

CONDUIT FITTINGS.—The Adapti Company of Cleveland has prepared catalog No. 106, descriptive of its conduit fittings.

RANGES.—The Standard Electric Stove Company, Toledo, Ohio, has prepared a catalog descriptive of its complete line of electric ranges.

APPLIANCES.—The Electric Construction Company of Little Rock, Ark., is preparing a new catalog and price list file on all electrical supplies.

RANGES.—The S. P. Stove Company of Wilmette, Ill., has prepared brochure No. 2, descriptive of its S-P electric stoves, ranges and appliances.

TAPS AND DIES.—The Greenfield Tap & Die Company of Greenfield, Mass., has prepared a manual containing instructions and information issued to its employees.

STOKERS.—The Laclede-Christy Clay Products Company of St. Louis has issued a folder the title of which is "How Can I Offset the Increased Cost of Coal?"

ELECTRICAL SUPPLIES.—The Mohawk Electrical Supply Company, 325 South Warren Street, Syracuse, N. Y., is distributing its 1917 electric fan price list.

POLE JACK.—The Templeton-Kenly Company, Ltd., 1022 South Central Avenue, Chicago, Ill., is distributing an illustrated folder descriptive of its "Simplex" pole jacks.

FLOOR SURFACER.—The "American Universal" floor surfacer for all kinds of wood floors is illustrated and described in a bulletin recently issued by the American Floor Surfacing Machine Company of Toledo, Ohio.

REFLECTORS.—The National X-Ray Reflector Company of Chicago is distributing the May issue of "Eye Comfort," published to aid advocates of good lighting. This issue includes papers on showcase lighting, theater lighting, show-window lighting, church illumination and artistic fixtures for X-ray lighting.

APPLIANCES.—The Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has prepared an illustrated folder descriptive of three double-page *Saturday Evening Post* advertisements in four weeks, and big space in other magazines, used in opening the Westinghouse "reel" campaign.

ELECTRICAL APPARATUS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has prepared leaflets on motors for paper-finishing mills, crane-protective panels, headstock equipments for woodworking lathes, curve analyzing and recording devices, outdoor metering equipment, electrical speed indicators, type HB overload relays, portable fault localizers, potentiometers and synchronous-booster converters.

ELECTRICAL TRADES' DIRECTORY AND HANDBOOK.—The thirty-fifth annual edition of the *Electrician* (London) "Electrical Trades' Directory and Handbook" has been received. Among the contents of the handbook section are a full digest of the law of electric lighting, electric power, electric traction, telegraphs and telephones, by A. C. Curtis-Hayward, and a digest of the law relating to patents, trademarks and designs, a list of the patents expiring in 1917, etc.; the various rules for the installation of electric light, power and traction in England, including the fire risk rules of the leading fire offices, the regulations of municipal authorities relating to electricity supply, etc.; the government regulations for the use of electrical energy in factories and workshops, and the regulations affecting the application of electricity to mines and collieries in Great Britain, the British colonies and the principal mining centers of the world; financial details relating to electrical joint stock enterprises, and information relating to the financial side of every branch of the industry; electrotechnical tables and data relating to electricity supply and traction, telegraphy and telephony, electrochemistry, etc. The directory division contains the name and address of virtually every person engaged in the electrical profession and industry throughout the United Kingdom. The classified trades section is complete. Sections are devoted to the British colonies, to the continent of Europe, to Asia and Africa, Central and South America, and the United States. These contain particulars of all officials in the electrical, telegraphs, radio, railways and tramways, and works departments of the governments of the world. There are in all about 1500 pages in the book, which is published at 15 shillings net.

New England States

BAR HARBOR, ME.—The Public Utilities Commission has granted its approval of a contract between the Bar Harbor & Union River Power Company and the American Smelting & Refining Company, whereby the former will furnish electricity for the mining operations at Bluehill. The contract is for a period of six months, with the privilege of renewal for two years and six months. The contract will necessitate additions to the power plant at Ellsworth.

BROWNVILLE JUNCTION, ME.—Bids will be received until June 26 for the construction of buildings at Brownville Junction, including 18-stall, semi-permanent engine house, machine, wheel and power house, 155 ft. by 50 ft.; boarding house, three-story and basement, frame building, 90 ft. by 45 ft. Also for construction at Holeb, Maine, of a single-track mechanical coal plant of 75 tons capacity. Plans and specifications may be obtained upon application to resident engineer C. P. R., Brownville Junction.

FORT FAIRFIELD, ME.—The Public Utilities Commission has granted the Limestone Light & Power Company permission to furnish electrical service in certain portions of the town of Fort Fairfield.

WEST POWNAL, ME.—Bids will be received by the board of hospital trustees for the Maine School for Feeble-Minded, addressed to Dr. Carl J. Hedin, superintendent, West Pownal, Me., until June 30, for construction of power house, conduit system, etc. Plans and specifications may be obtained at the office of Arthur B. Fels, 60 Union Street, Portland, Me.

CHESTER, MASS.—The purchase of the electric plant of the Chester Electric Light Company, to be owned and operated by the municipality, is under consideration.

NEWPORT, R. I.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 18 for furnishing and installing turbo-alternators, condensers, pumps, exciters, boilers, stokers, draft fans and piping at the naval training station, Newport, R. I. Specifications (No. 2362) may be obtained upon application to the above bureau or to the commandant of the naval station named.

WATERBURY, CONN.—The Chase Companies, Inc., of Waterbury, has petitioned the Public Utilities Commission for approval of the construction of an electric transmission system from the Chase Metal Works in Waterville to the Chase Rolling Mill Company in Waterbury.

Middle Atlantic States

BINGHAMTON, N. Y.—The City Council is considering the establishment of an ornamental lighting zone as permitted by the new charter.

BROOKLYN, N. Y.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 19 for furnishing blading for Curtis turbines, brass, phosphor bronze, bar and sheet copper, sensitive drill, milling machine, pipe fittings, brass pipe, copper tubing, brass voice-tubing unions, valves, etc. Proposal blanks may be obtained on application to the above bureau or to the supply officer, Navy Yard, Brooklyn, N. Y.

BUFFALO, N. Y.—The power house of the Pennsylvania Railroad Company on Babcock Street is being enlarged.

BUFFALO, N. Y.—The H. G. Trout Company of Buffalo is building a new foundry building and power house in connection with its iron works at Ohio and Moore Streets.

BUFFALO, N. Y.—Bids will be received by the Lighthouse Inspector, Buffalo, N. Y., until June 23 for furnishing four electric generating units. For details see Searchlight Section.

CLIFTON (BOROUGH OF RICHMOND), N. Y.—Plans have been filed by Dr. L. A. Dreyfus for a two-story brick power house at Clifton, to cost about $25,000, adjoining his rubber factory. Contract for construction of building has been awarded to the Turner Construction Company, 11 Broadway, New York, N. Y.

COOPERSTOWN, N. Y.—The Public Service Commission has approved the merger of the Hartwick (N. Y.) Power Company, the Deposit (N. Y.) Electric Company and the Southern New York Power Company of Walton into the Colliers Light, Heat & Power Company, and extensions of the transmission lines of the Standard Light, Heat & Power Company of Unadilla through the town of Guilford, Chenango County, to connect with the lines of the Norwich (N. Y.) Gas & Electric Company. The new lines of the Standard company will also distribute electricity in the town of Guilford.

FREDONIA, N. Y.—The Board of Trustees has authorized H. C. Drake, village president, and Arthur Moore, village clerk, to enter into a contract with the Niagara & Erie Power Company to furnish electricity for lighting the streets and public places of the city for a period of five years. Heretofore energy has been generated at the municipal plant.

LOCKPORT, N. Y.—W. W. Wotherspoon, superintendent of public works, has denied the application of the city of Lockport for permission to divert water from the Erie Canal for municipal purposes. It was the intention of the city to use the water for generating electricity in connection with a proposed municipal electric light and power plant. The State authorities also informed the city that they would oppose any attempt to secure legislation that would authorize the diversion of water from the canal.

NEWARK, N. Y.—Bids will be received by Albert W. Beaven, president of board of managers of the New York State Custodial Asylum for Feeble-Minded Women, Newark, N. Y., until June 22 for furnishing two boilers; heating work, stokers, piping, etc., at the New York State Custodial Asylum for Feeble-Minded Women. Specifications may be seen at the Asylum, Newark; New York office of Department of Architecture, Room 1224, Woolworth Building, New York City. Drawings and specifications and blank forms of proposal may be obtained at the Department of Architecture, Capitol, Albany. Lewis F. Pilcher is state architect.

SALAMANCA, N. Y.—Work is under way on the construction of the new shop and power plant at the local yards of the Buffalo, Rochester & Pittsburgh Railroad Company. Westinghouse, Church, Kerr & Company of New York have the contract for construction of buildings.

YONKERS, N. Y.—The National Sugar Refining Company is contemplating the construction of a new boiler house at its plant at the foot of Main Street, to cost about $140,000.

BASKING RIDGE, N. J.—An election will soon be held to vote on the proposal to appropriate funds for an electric-lighting system for the township.

BERNARDSVILLE, N. J.—At special elections held June 5 the following townships have voted appropriations for street-lighting during the coming year: Livingston Township, Newmarket, Port Reading, Mountain Lakes, Little Falls and German Valley. The fund for the total work in these districts amounts to about $11,000.

GLOUCESTER, N. J.—The City Council is negotiating with the Public Service Electric Company for a new street-lighting contract, which is to include the installation of a new system, consisting of 60-cp. lamps in the business district and smaller lamps in other sections of the city.

IRVINGTON, N. J.—A new boiler plant, for factory operation, will be built by Kraeuter & Company, 571-585 Eighteenth Avenue, Newark, at their new tool-manufacturing plant being erected on Nye Avenue. The cost of the entire plant is estimated at about $160,000.

NEWARK, N. J.—The Nickelsburgh Brothers Company, manufacturer of leather, contemplates the erection of two one-story boiler plants at its factory on Meadow Street.

NEWARK, N. J.—The question of establishing a hydroelectric power station at the Wanaque water properties, recently acquired through agreement with the North Jersey District Water Supply Commission, will be investigated by the Board of Works.

NEWARK, N. J.—A boiler and engine house, one story, will be erected at the new plant of the Alcohol Products Company at the foot of Blanchard Street. The cost of the entire work is estimated at $75,000. Frederick A. Phelps, Union Building, is architect.

SALEM, N. J.—The City Council is considering the installation of a new engine, pumping equipment, etc., at the local water-works station, to provide for emergency service.

WEEHAWKEN, N. J.—Bids will be received by the board of education, West New York, until June 20 for electrical work and heating in Public School No. 6. Harry Kuhlke is clerk of board.

EASTON, PA.—The Pennsylvania Utilities Company is installing a 3500-kw. turbo-generator at its plant on Dock Street. Arrangements are also being made by the company to install four new boilers.

ELMHURST, PA.—The citizens of Elmhurst have organized a board of trade and will establish a water and sewer system and an electric-lighting plant and also the extension of the Moosic Lake electric railway into the borough and other public improvements.

HAMBURG, PA.—The Metropolitan Electric Company of Reading has recently entered into a contract to supply energy for the central station of the Hamburg Gas & Electric Company.

JOHNSTOWN, PA.—Arrangements have been made by the Pennsylvania Electric with the Standard Quemahoning Coal Company for furnishing energy for mining operations. The coal company will install new electric haulage and other apparatus.

MILLERSBURGH, PA.—The Millersburg Electric Light, Heat & Power Company has begun work on the erection of a new electric transmission line to Halifax. Improvements are being made to the local station, including the installation of new boiler and other equipment.

MORRELLVILLE, PA.—Following the loss of its power plant by fire on May 29 the Morrellville Coal Mining Company has contracted with the Citizens' Light, Heat & Power Company of Johnstown to furnish energy for mine haulage and other operations at its properties. The company, it is understood, will rebuild the power station. Post office address, Johnstown.

READING, PA.—The City Council has approved an appropriation of $15,000 for improvements to the city fire alarm system.

ST. PETERSBURG, PA.—Contract has been awarded by General Utilities & Operating Company of Baltimore, Md., which owns and operates the St. Petersburg Electric Light & Power Company for a 4000-kw. steam turbine to be installed in the local plant.

YEADON, PA.—The Theodore Presser Company of Philadelphia has awarded the contract for the erection of a power house to cost $20,000 at its printing plant in Yeadon to the Wills-Ludwick Company, 34 South Seventeenth Street, Philadelphia.

WILMINGTON, DEL.—Plans have been filed by the Wilmington & Philadelphia Traction Company for an addition to its power station on the Brandywine River.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company is contemplating the erection of an addition 36 ft. by 67 ft., to its Lexington Street plant, to be used for an engine house.

BALTIMORE, MD.—The contract for the construction of an engine house, 36 ft. by 67 ft., one story, at the Spring Garden plant, has been awarded by the Consolidated Gas, Electric Light & Power Company to the B. F. Bennett Building Company, 123 South Howard Street, Baltimore.

RISING SUN, MD.—The town of Rising Sun has awarded a contract for the installation of a new electric-lighting plant.

SPARROWS POINT, MD.—Arrangements are being made by the Dundalk Company, recently incorporated with a capital stock of $5,000,000, to develop property at Sparrows Point for an industrial city. The work will include the installation of an electric-lighting system, which, with other work, will cost about $150,000. Edward H. Bouton, Munsey Building, Baltimore, is president of the company.

FIELDALE, W. VA.—Plans and specifications have been prepared for the development of 2000 acres for industrial city, with large textile mills, for Marshall Field & Company of Chicago, Ill. The plans provide for the construction of an electric-lighting plant, water-works, sewer system, etc. The work will be done under the management of George W. Fraker and E. D. Pitcher of Spray, N. C.; the former is president of the Carolina Cotton & Woolen Mills Company, controlled by Marshall Field & Company.

MARTINSBURG, W. VA.—The Potomac Light & Power Company is planning to remodel dam No. 5 plant and install two 1000-hp. vertical shaft units. Construction work will be done by the company under the supervision of Sanderson & Porter, consulting engineers, 52 William Street, New York, N. Y. Contracts for machinery have been awarded.

LYNCHBURG, VA.—Bids will be received by the Council Committee on Water, Lynchburg, until June 25 for construction of a municipal filtration plant and appurtenances for the city of Lynchburg, the work to be let either in whole or part as follows: (1) Filter building appurte-

Construction

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nances and machinery foundations; (2) hot-water-heating system; (3) filters, appurtenances and piping in buildings; (4) regulating apparatus and chemical feed devices; (5) coagulation and sedimentation tank and wash-water tower; (6) pumping equipment; (7) chlorine apparatus; (8) electrical equipment and wiring; (9) force main and distributing pipe. Plans and specifications may be obtained at the office of H. L. Shaner, city engineer, Lynchburg, upon deposit of $10.

RICHMOND, VA.—The City Council has awarded a contract to the P. J. White & Son Company for extensions to the municipal electric-light plant.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 1211—Miscellaneous blading for Curtis turbines; Schedule 1217—32,000 lb. brass wire, 5 lb. coils, 32,000 lb. soft copper wire. Philadelphia, Pa., Schedule 1211—miscellaneous turbine blading. Charleston, W. Va., Schedule 1220—three 6-ton electric furnaces; Schedule 1219—four motor-driven hydraulic power pumps for operating 500 and 3000-ton presses; Schedule 1218—two 500-ton hydraulic piercing presses, one 3000-ton hydraulic piercing press, including intensifier. Brooklyn, N. Y., Mare Island, Cal., Schedule 1205—eight fuel-oil heaters. Schedule 1221—two electric-driven portable drills, two motor-driven, 30-in. radial drills, two motor-driven, 16-in. sensitive drills, two motor-driven, two-wheel, column emery grinders, two motor-driven portable service grinders, two motor-driven 4-in. capacity hack-saws, two motor-driven back-geared extension gap, screw-cutting lathes, four motor-driven, all geared head, tool room, screw-cutting lathes, two motor-driven, constant-speed drive, universal milling machines, two motor-driven tool room column shapers. Boston, Mass., and Brooklyn, N. Y., Schedule 1217—miscellaneous full spring, bronze phosphor wire. Norfolk, Va., Schedule 1203—four quick-change gear, high duty, 16-in. screw-cutting engine lathes. Boston, Mass., Schedule 1202—one steam windlass. Norfolk, Va., Schedule 1214—13,800 lb. hard-drawn brass tubing; Schedule 1209—30,000 lb. brass tubing, tinned inside and out; Schedule 1212—3000 lb. seamless-drawn copper tubing. Newport, R. I., Schedule 1212—10,000 lb. seamless brass tubing, miscellaneous hard-drawn copper tubing. Various, Schedules 1209-1216—miscellaneous drawn seamless brass pipes; Schedule 1209—miscellaneous seamless copper tubing Puget Sound, Wash., Schedule 1209—miscellaneous hard-drawn seamless copper tubing. Brooklyn, N. Y., and Philadelphia, Pa., Schedule 1210—miscellaneous pressure-reducing light water and steam brass valves. Applications for proposal blanks should designate the schedule desired by number.

North Central States

CLEVELAND, OHIO.—Bids will be received by the commissioner of purchases and supplies, City Hall, Cleveland, until June 26 for rubber-covered, lead-incased cable for the division of light and heat. Specifications may be obtained at the office of the division of light and heat, Room 204, City Hall.

DAYTON, OHIO.—The power plant of the Dayton Power & Light Company on East Fourth Street is being remodeled.

FAIRFIELD, OHIO. — The Dayton (Ohio) Power & Light Company has offered to furnish the government electricity in any amount, at half rates, for service at the new aviation training field being established at Fairfield. If the offer is accepted, it is said, a transmission line will be erected to the field from the Huffman farm in the Springfield pike, a distance of 2 miles, or the line from the village of Osborn reconstructed.

HAMILTON, OHIO.—The Hancock Robernmeyer tract of land just beyond the eastern corporation limits of the city has been purchased by the Cincinnati Gas & Electric Company, which is to be used as a site for a large substation.

YOUNGSTOWN, OHIO.—The Brier Hill Steel Company is contemplating the construction of an additional blast furnace of 500 tons capacity at its works in the west end. A power station and boiler house for rolling mill will be erected in connection with the extension of the plant. Contract for furnace has been awarded to the Riter-Conley Company of Pittsburgh.

HAZARD, KY.—The capital stock of the Hazard Electric Light & Power Company has been increased from $20,000 to $25,000. Improvements are contemplated to the system.

BLOOMFIELD, IND.—The Public Service Commission has granted the Indiana Power & Water Company permission to purchase the electric-light and power plants in Vincennes, Dugger and Petersburg, owned by the Eastern Power & Light Corporation of New York, N. Y.

DECATUR, IND.—Plans have been prepared by the Fort Wayne & Decatur Traction Company for the erection of a substation, 23 ft. by 60 ft., in Decatur.

DUGGER, IND.—The Indiana Power & Water Company of Bloomfield has been given authority to purchase the local electric plant, owned by the Eastern Power & Light Corporation of New York, N. Y.

LIGONIER, IND.—The local electric-light plant, it is reported, has been purchased by the Indiana & Michigan Electric Company of South Bend. A transmission line 28 miles long, it is understood, will be erected to connect the local system with the lines of the Indiana & Michigan Company.

PETERSBURG, IND.—The Public Service Commission has given the Indiana Power & Water Company of Bloomfield authority to purchase the local electric-light plant, owned by the Eastern Power & Light Company of New York, N. Y.

VINCENNES, IND.—The Indiana Power & Water Company of Bloomfield has been granted permission by the Public Service Commission to purchase the properties of the Vincennes Electric Company and the City Electric Lighting Company, which are controlled by the Eastern Power & Light Corporation of New York, N. Y.

EDWARDSVILLE, ILL.—Steps have been taken by the Edwardsville Business Men's Association to make investigations relative to securing improvements to the street-lighting system in the business section of the city.

GIBSON CITY, ILL.—The City Council has instructed the city attorney to go ahead with the necessary legal proceedings for the construction of a municipal electric-light plant.

WAUKEGAN, ILL.—Plans, it is reported, are being considered by the Fulton-Alden Company, manufacturer of phonographs, for enlarging its factory buildings and equipping its plant for electric motor drive.

JUNCTION CITY, WIS.—The Wisconsin Valley Electric Company is contemplating the erection of a 44,000-volt electric transmission line from Mosinee to Stevens Point, a distance of 35 miles, with an extension to Junction City. The company has been granted a franchise to furnish electricity and given a contract for street-lighting in the latter city.

MILWAUKEE, WIS.—Contracts, it is reported, have been awarded by the Pawling & Harnischfeger Company of Milwaukee for new equipment for its plant, including a 500-kw. generating unit, consisting of a Nordberg poppet-valve engine, directly connected to an Allis-Chalmers generator. Two 300-hp. Badenhausen boilers will be installed. An addition, 50 ft. by 80 ft., is being erected to the power plant, to be equipped with a monorail bucket hoist, mechanical stokers and other apparatus. Two new 10-ton yard cranes are also being installed. Woodmansee &. Davidson of Milwaukee, Wis., and Chicago, Ill., are consulting engineers.

ALDEN, MINN.—Improvements to the local electric-lighting system are under consideration.

MINNEAPOLIS, MINN.—The Northern States Power Company of Chicago, Ill., has recently purchased the properties of the Northwest Light & Power Company of Hutchinson; the Renville County Electric Company of Bird Island, and the Minnesota Valley Power Company of Montevideo, all operating in southern Minnesota. The three companies serve 28 communities.

ELLSTON, IOWA.—The Mount Ayr (Iowa) Light & Power Company has been granted a franchise to supply electricity for lamps and motors in Ellston.

MASON CITY, IOWA.—The Board of County Commissioners has granted the People's Gas & Electric Company of Mason City a franchise to erect an electric transmission line from Morning Sun to Mediapolis.

NEVADA, IOWA.—Bids will be received by the Commissioners of Story County, Nevada, until June 20 for the construction of a brick building, 118 ft. by 92 ft., two stories and basement, including electric wiring, steam heating, dumb waiters, vacuum cleaner, etc. The cost of the building is estimated at $70,000. Damon & O'Mera, Mason Building, Fort Dodge, are architects.

RUTHVEN, IOWA.—The citizens have voted to grant the Northern Gas & Power Company a franchise to supply electricity in Ruthven.

TINGLEY, IOWA.—The citizens of Tingley have voted to grant the Mount Ayr (Iowa) Light & Power Company a franchise to furnish electricity here.

BERNIE, MO.—The town of Bernie has granted a franchise to G. N. Lasswell and C. L. Coble of Kennett, Mo., to install and operate an electric-light plant.

KANSAS CITY, MO.—Work has begun on the erection of a substation at Fifty-ninth Terrace and Swope Parkway for the Kansas City Railways Company.

KANSAS CITY, MO.—The Samuel F. Baker Motor Company of Kansas City is planning to equip a repair and garage plant and will receive bids until July 1 for equipment, including 20-in. drill presses, arbor presses, grinder and buffer, electric motors, compressor, etc. The cost is estimated at about $25,000.

ST. LOUIS, MO.—The Monsanto Chemical Works of St. Louis is contemplating the purchase of two 500-hp. water-tube boilers, stokers, etc.

MAX, N. D.—The Garrison (N. D.) Coal, Light & Power Company has submitted a proposal to the Commercial Club of Max offering to erect an electric transmission line to Max and furnish electrical service here. Frank McGray of Garrison is interested in the company.

RUGBY, N. D.—An ordinance has been adopted by the City Council granting the Northern States Power Company of Chicago, Ill., permission to install and operate an electric-lighting system in Rugby.

VALLEY CITY, N. D.—The Cheyenne Valley Light & Power Company, recently organized, is planning to erect a high-tension transmission line from Valley City to Dazey, Sanborn, Rogers and other places in this part of the state. Energy for operating the proposed system will be obtained from the municipal plant at Valley City. Later the line may be extended to Hannaford and Wimbledon.

HUMPHREY, NEB.—The local electric light company has been reorganized. The new owners, it is understood, propose to rebuild the electric distributing system and furnish an unlimited service. Frank Wheeler is local manager.

OGALALLA, NEB.—At a special election held June 5 the proposal to issue bonds for a new steam power plant and for extensions to the distributing system was carried. James H. Class is superintendent.

OMAHA, NEB.—Work has begun on the construction of a hospital building for the Swedish Mission Hospital, to cost about $100,000. Bids are wanted on all sub-contracts, including electric wiring, coal chute, fire escapes, etc. Julien Swanson, 2434 Pratt Street, is architect.

STERLING, NEB.—Bids will be received by R. F. Frerichs of the board of education of school district No. 93 of Sterling, until June 26 for the construction of a new school building. Separate bids to be submitted for heating, plumbing and electric work. Plans and specifications may be obtained upon application to Berlinghof & Davis, architects, Security Mutual Life Building, Lincoln, upon deposit of $25.

ATWOOD CITY, KAN.—At an election to be held June 19 the proposal to issue $20.000 in bonds for extensions and improvements to the electric-lighting system will be submitted to the voters.

BURLINGTON, KAN.—The City Council has instructed the city clerk to secure estimates of the cost of an additional Corliss engine and generator for the municipal electric-light plant.

COFFEYVILLE, KAN.—The Union Traction Company, operating in Coffeyville and Independence and interurban lines, has entered into a contract with the Kansas City Gas & Electric Company of Wichita to supply energy to operate its system from Parsons, Kan., to Nowata, Okla.

DOUGLAS, KAN.—At an election held recently the proposal to issue $5,000 in bonds for the installation of an electric-lighting system was carried.

FLORENCE, KAN.—Improvements are contemplated by the Florence Electric Company this summer, including the installation of a 50-kw., three-phase, 60-cycle generator.

OBERLIN, KAN.—The city of Oberlin is considering the installation of a municipal electric-light plant.

ST. MARYS, KAN.—The City Council is considering a proposal submitted by D. A. Course of the Rocky Ford Power Company to supply electricity in St. Marys. The company, it is reported, has made arrangements to supply energy in Alma and McFarland and will cross the river at Wamego.

TORONTO, KAN.—Contracts have been awarded by the city of Toronto for equipment for the proposed municipal electric-light plant. W. B. Rollins & Company, Railway Exchange, Kansas City, Mo., are engineers.

Southern States

BRIDGEWATER, N. C.—The Western Carolina Power Company of Charlotte is contemplating the construction of a 25,000-kva. hydroelectric plant near Bridgewater and another plant to develop about 70,000 kva. near Camden, S. C. The construction of these two plants will necessitate the extension of transmission lines and the erection of a new substation, etc.

CAMDEN, S. C.—The construction of a new 70,000-kva. hydroelectric plant near Camden is under consideration by the Western Carolina Power Company of Charlotte, N. C. The company is also considering the erection of another plant near Bridgewater, N. C., to develop about 25,000 kva.

PORT ROYAL, S. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 25 for construction of eight wood frame officers' quarters, including electric-lighting, plumbing and sewer systems, at the marine recruiting station, Port Royal. Drawings and specification No. 2405 can be obtained upon application to the above bureau or to the commandant of the naval station.

UNADILLA, GA.—The bond issue for the proposed municipal electric plant having been defeated, C. B. Morgan, Mayor, is considering granting a franchise for an electric plant.

MEMPHIS, TENN.—Bids will be received by the Mississippi River Commission, U. S. Engineer Office, Custom House, Memphis, Tenn., until July 2 for furnishing one troughing belt conveyor, one centrifugal discharge belt elevator complete with drive engine, one concrete mixer, bucket and distributing boom complete with drive engine and boiler; one steam capstan and one cement sack elevator complete.

FAYETTE, MISS.—Bonds to the amount of $17,000 have been voted for improvements to the municipal electric-light plant.

McCOMB, MISS.—Work will begin immediately on the construction of an interurban electric railway to connect McComb, Magnolia and Summit. The power plant to furnish energy to operate the line will be located at Fernwood, where waste from the large lumber mills will be used. Right-of-way for the entire length of the road has been obtained. A. H. Jones is manager.

BATESVILLE, ARK.—Bids will be received by the Board of Commissioners, Water and Light Improvement District No. 1, Batesville, Ark., until June 26 for furnishing and installing a 150-kva., three-phase, 60-cycle, 2300-volt generator and a single cylinder, four-valve-type counter-flow or uniflow unit, to operate condensing, directly connected. Specifications may be obtained from Frank L. Wilcox, engineer, Syndicate Trust Building, St. Louis, Mo., upon deposit of $5.

CAMDEN, ARK.—The Camden Electric Gin Company is contemplating installing an electrically operated plant, having a daily capacity of 50 bales.

PARIS, ARK.—Bids will be received by the Electric Light Improvement District, recently organized to establish an electric-light and power system, until June 29, for construction of power plant, the work to include a power house, 30 ft. by 86 ft., two 100-hp. boilers, two water-feed pumps, one 140-hp. steam engine and a 120-kva., three-phase, 60-cycle, 2300-volt engine-type generator, with exciter, switchboard, etc. W. N. Gladson of Fayetteville, Ark., is consulting engineer.

ADA, OKLA.—The Oklahoma Power & Transmission Company is planning to build electric plants at Ada and Shawnee, to cost about $500,000. The plans provide for a development of from 7000 to 10,000 kw. for transmission to Ada, Shawnee, Lawrence, Fitzhugh, Roff, Tupelo, Stonewall, Colgate and other places. The work will include construction of power house, equipped with two 3500-kw. steam turbines, 12 Heine boilers, etc.; also the erection of substations and about 100 miles of electric transmission lines. The work will be done under the supervision of W. H. Zimmerman of the W. H. Zimmerman Company of Chicago, Ill. Sinclair Mainland of Chicago, Ill., is president.

CUSHING, OKLA.—The Oil Field Water, Light & Power Company, recently organized with a capital stock of $250,000, is planning to supply electricity for lamps, heaters and motors in the cities of Drumright, Cushing, Yale, Stillwater and other towns in this vicinity. It will also furnish energy to pump wells in the Cushing oil fields.

OKLAHOMA CITY, OKLA.—The State Capitol Commission has awarded the contract for construction of power house, 70 ft. by 100 ft., to the Gross Construction Company of Oklahoma City, at $62,500. Layton & Smith of Oklahoma City are architects.

STILLWATER, OKLA.—F. M. Redlick of the Oklahoma Agricultural and Mechanical College, Stillwater, would like to receive prices on electrical equipment for science hall and gymnasium armory buildings, to cost $100,000 each.

SUPPLY, OKLA.—At an election to be held June 25 the proposal to issue $6,000 in bonds for the installation of an electric-light system will be submitted to the voters.

COLLEGE STATION, TEX.—Work will soon begin on the installation of ornamental lamp standards on the campus of the Agricultural and Mechanical College of Texas. F. C. Bolton is professor of electrical engineering.

COLUMBUS, TEX.—The Columbus Electric Light Company has leased the municipal water-works system for a period of 12 months. New machinery will be installed and the pumping facilities enlarged.

PORT ARTHUR, TEX.—An addition is being built to the local power station of the Eastern Texas Electric Company of Beaumont. New equipment, including a 4000-kw. turbo-generator, will be installed.

Pacific and Mountain States

CHEWELAH, WASH.—The Washington Magnesite Company has closed a contract with the Stevens County Light & Power Company of Colville for furnishing 1000 hp. at its mine and plant near Chewelah. To furnish the service the power company will have to extend its transmission lines about 8 miles from Chewelah. R. S. Talbot of Spokane is president of the Washington Magnesite Company.

NEWPORT, WASH. — The Northern Idaho & Montana Power Company is erecting a 11,000-volt, three-phase, 60-cycle transmission line from Newport to Dalkena, Wash. The transformer station will have an initial capacity of 300 kva.

OKANOGAN, WASH. — The Okanogan Valley Power Company of Brewster, it is reported, will rebuild its distributing system within the corporate limits of Okanogan.

SEATTLE, WASH.—Plans have been completed by the Pacific Telephone & Telegraph Company, Stuart Building, for improvements in the Yakima Valley, to cost about $100,000. From $15,000 to $20,000 will be spent in North Yakima in underground work and aerial cables and about $75,000 for extensions in the valley.

SEATTLE, WASH.—Bids will be received by C. B. Bagley, secretary board of public works, Seattle, until June 22 for furnishing four oil switches for the auxiliary steam electric station at Eastlake Avenue and Nelson Place, and for two transformers for a substation tie line between the Seventh Avenue substation and the steam plant; also for furnishing one 500-kw. motor-generator set for the Aloha Street substation.

SHELTON, WASH.—The property of the Shelton Electric Company has been purchased by T. E. Donaldson and W. G. Burger, who will operate the plant under the name of the Shelton Light & Power Company.

TACOMA, WASH.—The Wheeler-Osgood Company of Tacoma is planning to equip its sawmill for electrical operation, which will increase the output from 150,000 to 170,000 ft. per day. The new equipment will include four 465-hp. turbines, three boilers, one generator and one turbine. The cost of the work is estimated at $60,000.

CRANE, ORE.—Preparations are being made by Johnson & Johnson of Vale for the construction of a large irrigation project for Harney County, covering about 50,000 acres of land. The plans provide for the erection of a large pumping plant on Lake Malheur. Energy will be furnished by the Harney Hydro-Electric Company, which will develop about 5000 hp., about 18 miles above Drewsey on the Malheur River. The power company will also supply electricity for lighting purposes in Harney Valley, including Crane.

LOS ANGELES, CAL.—The Southern California Edison Company has petitioned the State Railroad Commission for permission to issue 10,000 shares in capital stock at $88 per share.

LOS ANGELES, CAL.—Plans have been filed by the Los Angeles Shipbuilding Company for the construction of its shipbuilding works on Smith's Island, Los Angeles Harbor. The cost of the initial plant is estimated at $750,000 and will consist of a one-story machine shop, 100 ft. by 400 ft.; one-story foundry, 100 ft. by 300 ft.; one-story rivet shop and storage, 80 ft. by 300 ft.; one-story boiler shop, 100 ft. by 200 ft.; two-story general construction works, 100 ft. by 600 ft.; carpenter shop, 100 ft. by 300 ft.; one-story pipe shop, 100 ft. by 200 ft.; one-story electric shop, 90 ft. by 150 ft., and one-story general warehouse, 100 ft. by 350 ft. An aerial tramway and electric traveling cranes will be installed. The works will include four shipbuilding berths, 60 ft. by 500 ft. each, and wharf of same size. F. A. Gardner is chief engineer.

RIVERSIDE, CAL.—The City Council has adopted a resolution providing for the installation of an ornamental lighting system on Chestnut Street from First to Sixth Street.

VENTURA, CAL.—The installation of an ornamental lighting system in Ventura is under consideration.

EAGLE, IDAHO.—Surveys are being made by the Idaho Power Company of Boise for the erection of an electric transmission line from Eagle to what is known as the Wise Project, a distance of about 3 miles, to furnish electricity to irrigate a tract of approximately 700 acres.

WALLACE, IDAHO. — The Shoshone County Power Company, recently organized, proposes to erect and operate an electric transmission line from a point near the Ray-Jefferson mine and thence to Prichard Creek, down Prichard Creek to Murray, a distance of 12 miles, with laterals, branches and extensions, which will cost between $30,000 and $35,000. The line when completed will furnish energy for extensive dredging operations to be carried on along Prichard Creek by the Guggenheim interests.

MONROE, UTAH.—At a citizens' meeting held recently the proposal to rebuild the electric power plant, destroyed by fire on Feb. 22, was carried.

HARLOWTON, MONT.—The installation of an ornamental lighting system on Central Avenue is reported to be under consideration.

LIVINGSTON, MONT.—Bids will be received at the office of H. J. Reece, city clerk, Livingston, until June 26 for construction of water-works system, separate bids to be submitted as follows: (1) For furnishing material and labor and constructing concrete settling basins, filter basins, clear-water basin, filter and chemical house, pumping station and concrete reservoir, and erecting pumps, motors, etc.; (2) for furnishing and erecting four 750,000-gal. mechanical units; (3) for furnishing two 1,500,000-gal. low service and two 1,500-000-gal. high-service, motor-driven pumps, starters, etc.; (4) furnishing cast-iron pipe, specials, etc.; (5) furnishing hydrants, valves, etc.; (6) for trenching and laying cast-iron pipe, etc. Copies of plans and specifications may be obtained at the office of Burns & McDonnell, engineers, Interstate Building, Kansas City, Mo., upon deposit of $10.

BURNS, WYO.—Bonds to the amount of $17,000 have been sold, the proceeds to be used for the construction of a light and water plant.

BURNS, WYO.—The contract for furnishing and installing the electric equipment and machinery for the municipal electric-light plant has been awarded to the Cheyenne (Wyo.) Light, Fuel & Power Company.

ROCK SPRINGS, WYO.—The Union Pacific Coal Company of Cheyenne is planning to install a new 2500-kw. General Electric turbine in its local power plant, and to erect a new electric transmission line from Rock Springs to Superior, a distance of 19 miles. Wooden poles and No. 4 copper wire will be used. Energy will be transmitted either at 33,000 or 44,000 volts. Work has already begun on the power house in Rock Springs. The power plant at Superior will be used as an auxiliary. A new 1000-kw. General Electric turbine will also be installed at the company's plant at Hanna, where it is opening a new coal mine. Improvements involving an expenditure of about $200,000 will be made in Hanna.

Canada

HOLLYBURN, B. C.—The British Columbia Electric Railway & Power Company of Vancouver is contemplating extending its transmission lines to Hollyburn to furnish electrical service here.

NELSON, B. C.—Arrangements have been made whereby the Utica Mines, Ltd., and the Jackson Basin Mines, Ltd., both of Nelson, will construct jointly a hydro-electric plant on Twelve-Mile Creek. The Utica Mine now has a 100-hp. plant. Charles F. Caldwell of Kaslo, B. C., is interested.

PRINCE RUPERT, B. C.—The City Council is considering engaging an engineer to examine water-power sites in this section with a view of developing further hydroelectric power.

BATHURST, N. B.—The Bathurst Electric & Water Power Company has petitioned the New Brunswick Legislature for an amendment to its charter giving it authority to operate an electric railway in Bathurst and vicinity.

FORT WILLIAM, ONT.—Preparations are being made by J. A. Kellough, 240 Balmoral Street, Fort William, for the construction of a creamery, to cost about $7,500. Mr. Kellough is reported to be in the market for refrigerating machinery, motor, shafting, pulleys, ice crusher, boiler, etc.

NIAGARA FALLS, ONT.—The control of the Ontario Power Company of Niagara Falls will pass on Aug. 1, 1917, to the Hydro-Electric Power Commission of Ontario. The consideration is said to be $22,669,000. With the control of the new property the Hydro-Electric Power Commission will operate the largest hydro-electric system in the world.

GREENFIELD PARK, QUE.—Arrangements have been made by the Town Council with the Montreal (Que.) Light, Heat & Power Company for furnishing energy in connection with the proposed new street and domestic lighting system.

HERBERTVILLE STATION, QUE.—The Central Electricity Company, recently incorporated with a capital stock of $99,000, proposes to construct and operate electric-light and power plants, etc. J. H. Bassard, J. R. Desbiens, A. Plourde are among the incorporators.

MONTREAL, QUE.—A contract has been placed by the Montreal Tramways Company with the Canadian General Electric Company for a 12,500-kw. steam turbo-generator, to be installed in the new power station at Hochelaga. It is to be delivered in April, 1918. The proposed improvements include a new substation, additional equipment and a conduit system linking up the various plants.

Record of Electrical Patents

Notes on United States Patents issued on June 5, 1917

14,310. CIRCUIT CONTROLLER; Winthrop K. Howe, Rochester, N. Y. App. filed June 9, 1916 (reissue). Circuit controller having three operative positions.

14,312. DEVICE FOR CONNECTING OUTSIDE WIRES TO BUILDINGS; Philip C. Ragotzky, Philadelphia, Pa. App. filed March 7, 1917 (reissue). For connecting telephone wires from poles to buildings.

1,228,392. SPEED-INDICATING APPARATUS; Henry E. Beighlee, Cleveland, Ohio. App. filed Nov. 8, 1916. Means for indicating or registering the speed or variation in speed of a plurality of machines, engines or rotating parts.

1,228,408. CIRCUIT BREAKER; Fremont J. Cleaver, Carnegie Borough, Pa. App. filed Nov. 1, 1915. Air-tight receptacle of glass preferably having integral therewith, and internal open-top reservoir or cut into which extend the terminals of the electric circuit to be protected.

1,228,449. ELECTRIC MOTOR; Samuel E. Kurtz, Sac City, Iowa. App. filed Feb. 26, 1914. Variable-speed electric motor.

1,228,450. ELECTRIC WELDING MACHINE; Laurence S. Lachman, New York, N. Y. App. filed Sept. 17, 1915. Spot welders.

1,228,547. PROCESS OF MAKING PASTED STORAGE-BATTERY PLATES; Louis H. Flanders, Jenkintown, Pa. App. filed Oct. 20, 1913. A quantity of sulphate is mixed in the paste prior to its being applied to the grid, and the porosity of the finished plate is fixed and determined independently of the consistency thereof but with regard to the density of the lead oxide or oxides used and to the capacity desired.

1,228,551. NEGATIVE-POLE PLATE FOR STORAGE BATTERIES AND PROCESS OF MAKING THE SAME; William G. S. Grant, Hamilton, Ontario, Canada, and Louis H. Flanders, Jenkintown, Pa. App. filed Oct. 8, 1913. Active material is free from cracks.

1,228,577. ELECTRICAL PLUG AND SOCKET; James F. McElroy, Albany, N. Y. (Susie H. McElroy, executrix). App. filed Feb. 27, 1912. For temporary connection of an electrical device such as an electric heater to a supply circuit of high potential.

1,228,635. LAMP DIMMER; Harry Alexander, New York, N. Y. App. filed March 9, 1915. May be regulated within very narrow limits.

1,228,670. FLEXIBLE INSULATED ELECTRICAL CONDUCTOR; John C. Henderson, Washington, D. C. App. filed Nov. 3, 1916. Conductor having subdivided conducting portions in which there will be no readily combustible material touching the conducting elements.

1,228,675. STORAGE-BATTERY PLATE; William S. Hutchinson, Montreal, Quebec, Canada. App. filed July 16, 1913. Improvements.

1,228,710. BRUSH-LIFTING MECHANISM; Charles W. Steen, Norwood, Ohio. App. filed June 19, 1914. Improvements.

1,228,711. CONNECTING DEVICE FOR CHAIN-TYPE INSULATORS; Louis Steinberger, Brooklyn, N. Y. App. filed Dec. 6, 1912. Adjacent units may be readily assembled and disassembled without the use of tools.

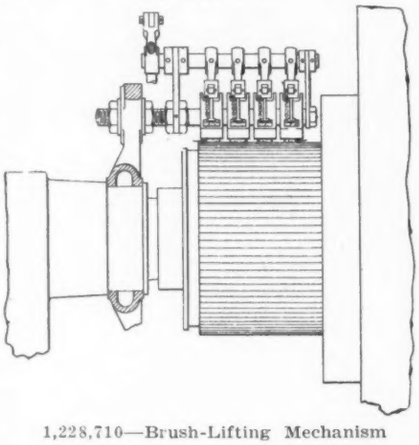
1,228,731. CIRCUIT EXTENSION BOX; Chauncey W. Abbott, Auburn, N. Y., and Henry R. Gilson, Baden, and James M. G. Fullman, Sewickley, Pa. App. filed May 26, 1914. Form of extension box whereby a circuit may be picked up at and extended from wall switch outlets, particularly flush switch outlets.

1,228,762. ELECTRIC LIGHT FIXTURE; C. F. Dolle, Cincinnati, Ohio. App. filed Sept. 14, 1912. Incandescent electric lights may be extensibly or adjustably supported from the wall or ceiling.

1,228,778. KNIFE-SWITCH RELAY; William Kaisling, Chicago, Ill. App. filed July 1, 1913. Armature-actuated switch blade is adapted to control circuit conditions in connection with a plurality of stationary switch blades.

1,228,839. SAFETY MEANS FOR SWITCH BOXES; Lester Siebenhauer, San Francisco, Cal. App. filed Sept. 27, 1915. Protecting covering for the exposed busbars and in spaced relation thereto, the covering being either of conducting or non-conducting material and either opaque or transparent as desired.

1,228,842. ELECTRIC WELDING MACHINE; James M. Sparkes, Peabody, Mass. App. filed Jan. 17, 1916. Single-transformer electric-welding apparatus.



1,228,710—Brush-Lifting Mechanism

1,228,843. WELDING MACHINE; William H. Spire, Cleveland, Ohio. App. filed Jan. 31, 1917. A platen longitudinally movable of the frame of the apparatus may be supported on and movable over a plurality of sets of bearing rolls in order to effect such longitudinal movement.

1,228,849. SYSTEM OF ELECTRICAL REGULATION; William A. Turbayne, Niagara Falls, N. Y. App. filed June 2, 1913. Storage batteries are caused to discharge into the system at periods of load demand greater than that desired to be held on the generators, while conversely the batteries are caused to charge when the external demand falls below the desired normal generator load.

1,228,852. CONTROL OF ALTERNATING-CURRENT MOTORS; Thomas W. Varley, New York, N. Y. App. filed June 18, 1914. Insures that the rotation of the motor will be always in the desired direction after it is once installed, independent of the reversal of the phases by accident or otherwise.

1,228,858. ELECTRIC SWITCH; Roger S. White, Washington, D. C. App. filed Oct. 31, 1914. Improvements.

1,228,859. METER SWITCH; Roger S. White, Washington, D. C. App. filed Aug. 22, 1916. For use particularly on meter test blocks.

1,228,907. ELECTRIC-SWITCH MECHANISM; David D. Gordon, Chicago, Ill. App. filed Nov. 21, 1916. Key-controlled snap-switch type.

1,228,924. DRAWN-LINK ELECTRIC FUSE; Slaughter W. Huff, Brooklyn, N. Y. App. filed Aug. 21, 1914. Cartridge.

1,228,936. COMMUTATION DEVICE FOR DIRECT-CURRENT MACHINES AND THE LIKE; Birger Ljungstrom and Axel D. Widstrom, Stockholm, Sweden. App. filed Feb. 24, 1913. Arrangement which will produce practically perfect commutation, but which will at the same time not disturb the magnetic design of the generator.

1,228,963. APPARATUS FOR CONTROLLING MECHANISM AT A DISTANCE; Jacob Perepelkin, Petrograd, Russia. App. filed Feb. 3, 1912. Improvements.

1,228,988. MACHINE FOR WATERPROOFING FIBROUS MATERIALS; Alfred O. Tate, Montreal, Quebec, Canada. App. filed Oct. 27, 1916. Improvements.

1,229,014. FIELD-CONTROL SWITCH; Winfield A. Atwood, Schenectady, N. Y. App. filed June 28, 1913. For dynamo-electric machines.

1,229,034. BURGLAR ALARM; Lee A. Collins, Louisville, Ky. App. filed Dec. 14, 1916. Transmits a signal to a central telephone office or other station with which it is connected by telephone.

1,229,056. ELECTRIC-LAMP RECEPTACLE; Melchor H. Freixas, Brooklyn, N. Y. App. filed Sept. 30, 1916. Improvements.

1,229,057. CARD-PUNCHING DEVICE; John W. Fritch and Delia E. Hoppes, Washington, D. C. App. filed Oct. 11, 1916. Such as those which are used for statistical data, as for instance in compiling statistics for the census or other similar uses.

1,229,075. APPARATUS FOR HANDLING METALLIC LEAF; Leon M. Harwood, Springfield, Mass. App. filed July 3, 1916. Improvements.

1,229,097. OIL-FEED SIGNAL DEVICE; Frank P. Lamar, Santa Ana, Cal. App. filed May 13, 1916. Device for indicating the flow of oil through an oil system.

1,229,128. ELECTRIC HEATING DEVICE; Leon F. Parkhurst, Pittsfield, Mass. App. filed June 18, 1915. Armored or sheathed wires lie in a single plane, so that the articles operated upon are uniformly spaced from the source of radiant heat.

1,229,149. COMMUTATOR; Carl J. Schwarze, Adrian, Mich. App. filed March 28, 1916. Relates to the grouping of relatively insulated terminals.

1,229,150. PROCESS FOR TANNING AND IMPREGNATING MATERIALS BY MEANS OF ELECTRICITY; Botho Schwerin, Frankfort-on-the-Main, Germany. App. filed Sept. 8, 1914. The invention utilizes the fact that a tanning liquor may be carried through the hide by the electric current—that is to say, electro-osmotically—whereby the hide is able to take up the tanning and become converted into leather.

1,229,185. INCANDESCENT ELECTRIC LAMP PLUG; George J. Stichtenoth, Cincinnati, Ohio. App. filed March 15, 1917. Having a plug adapted to be interchangeably employed with sockets of different types.

1,229,186. SAFETY SWITCH; Alexander K. Sutherland, New Britain, Conn. App. filed July 31, 1915. Ordinary knife-switch type.

1,229,203. METHOD OF PURIFYING AND SEPARATING FINELY DIVIDED SUBSTANCES; Botho Schwerin, Frankfort-on-the-Main, Germany. App. filed Jan. 5, 1912. Utilization of the effects of the electric current on the transport of the smallest particles in a suspension, a mixture of suspensions, or in so-called colloidal solutions.